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VOL. VII. NEW YORK, MARCH, 1902. No. 1.

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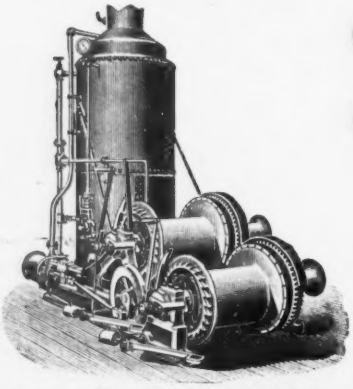

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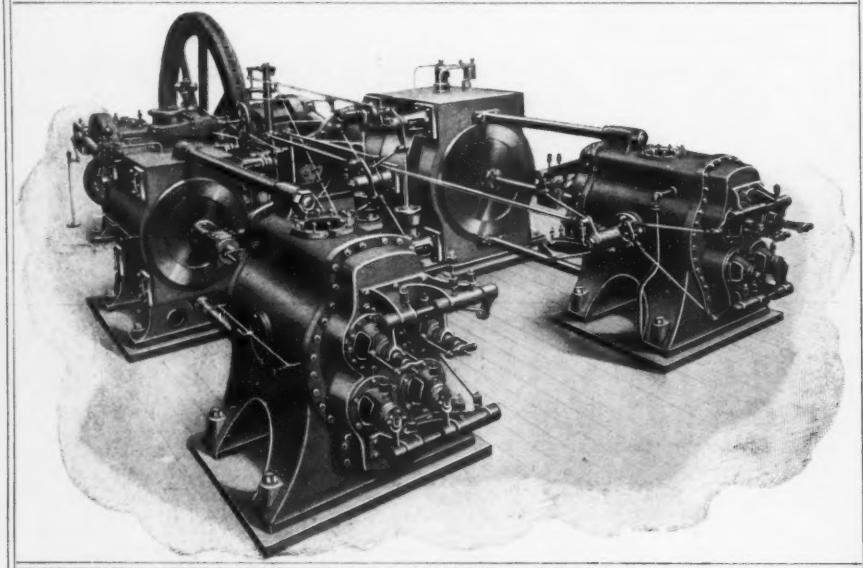

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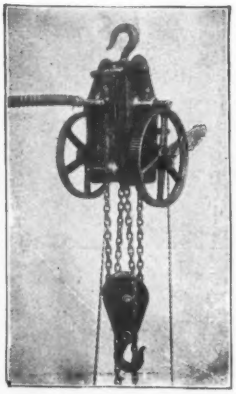

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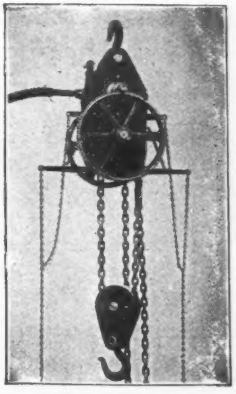

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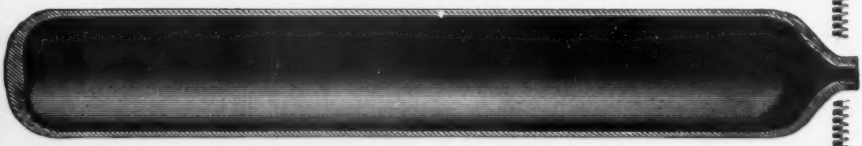

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We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

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Those who fail to receive papers promptly will please notify us at once.

Entered as Second-Class Matter at the New York N. Y., Post Office.

VOL. VII. MARCH, 1902. NO. 1.

This little paper was established in the month of March, 1896, so that with this issue we enter our seventh year. We began as papers usually begin, by producing a rather amateurish sheet of 16 pages, and have learned something by the experience of the past six years; at least our increased circulation and advertising patronage would so indicate. It is not uncommon now for us to issue from 56 to 64 pages each month. The most gratifying feature of this experience is our increased circulation, extending to many foreign countries. It appeared to us six years ago that compressed air had a field of usefulness that was capable of much industrial growth, and as there were few books on the subject, and no journals devoted to its interest, we started this little paper to give vent to an old-time hobby. We have never presumed to pose as experts, or as professors on this important subject, but we have thought that our every-day contact with compressed air machinery and men might give us a certain amount of practical information on the subject, and that this would be of interest to the public. Papers are published from time to time in the various engineering journals illustrating certain uses of compressed air, and as these papers are always in our files, we are able to select those of interest and embody them in this publication, together with a little occasional original matter. It would not be practical to publish even this little paper and fill its columns each month with original matter, that is, with papers written for us. If we attempted to do this, it is very likely that what we would produce would be of less value than when we avail ourselves of the large number of contributors to other journals. We have always attempted to give credit where credit is due, and as our readers are not likely to have either the time or the opportunity to look into all papers to see what is said about compressed air, we have undertaken to do this work for them. In the early issues of this paper we published a complete list of all pneumatic patents taken out in the United States, and have continued each month to select from the *Patent Office Gazette* everything that belongs to compressed air. That this paper is impartial goes without saying, for its record of six years is open for criticism. It is devoted to the interests and the development of an important industrial science, and not to any class or kind of machinery. Our advertising pages prove this, and with a continuation of the patronage which we have enjoyed, we hope and expect to go on towards increased prosperity and usefulness.

Protection.

It is just as important now to protect our manufacturers by securing and maintaining open markets for their surplus products as it was ten years ago to protect them in the home market against foreign competition. Europe then wanted us, we now want Europe.

All commerce to be permanent should be reciprocative. We cannot always sell unless we also buy.

We would follow the advice of President McKinley by using such of our tariffs as are no longer needed for protection or revenue for the purpose of increasing our trade abroad. This means tariff revision of a kind and in a way that could not produce a business collapse but which would pave the way for greater and continued prosperity. It was a serious matter to tinker with the tariff when Europe wanted us for a market and was held back only by the bars of protection. Even five years ago there was a scramble for American trade by foreign merchants, and a desire to get in here, while now conditions have changed and we are standing at the gates of foreign nations with products better and cheaper than theirs seeking their markets. The men who once wanted to sell us their goods are now ready to buy ours. In such a condition of things as this, why should we apprehend any danger from tariff tinkering on the McKinley basis? Does anyone believe that a reduction of 50 per cent. on iron and steel products would produce even a ripple of disturbance to our business? The alarm about the tariff is an inheritance which became rooted at a time when conditions were almost directly the reverse of what they are to-day. Professional politicians and professional protectionists are the alarmists who control the situation to-day at Washington.

The people will not long sustain a condition which cannot logically and fairly be justified. If trusts and combinations are to remain permanently as a part of our industrial system, they must be conducted in the interests of the whole people. The most vulnerable thing about a trust is where it can be shown that legislation has been called to the support of the trust to aid it in stifling competition. We cannot reasonably justify a protective tariff on a trust-made product. At the time the Dingley tariff bill was passed there were few of our industries controlled by trusts. To-day there are but few of the large manufacturing industries that are not controlled by trusts. Where there is internal competition the people are protected against monopoly profits, but in a trust-made product the importing point alone limits the price. At present prices in some trust-made products are close to the importing point, it follows that the tariff is a means by which monopoly profits are secured. Such a tariff is a tax upon one class of people for the benefit of another, and as such it violates the Constitution of the United States.

What we want is markets, not protection. We build by machinery, and our productive capacity is so great that the world's market is needed to maintain its stability. It is better to provide markets for our surplus than to curtail our product and discharge our workmen. The more we build of the same thing the greater profit do we make, and at a lower cost of production. This is one of the reasons for our present prosperity. Mechanical appliances that lower cost are made possible only by a large output. Our productive capacity per man employed is made greater by machines, and in order to employ all of our labor and at good wages we must enlarge our markets. At one time in the Carnegie works 800 men were employed in a department that produced 1,200 tons of steel. By the use of improved machinery 1,500 tons were produced by 65 men. According to Labor Commissioner Wright, an American farm hand raises as much grain as three in England, four in France, and five in Germany.

A protective tariff does not benefit the mining-machinery trade. Few in this business know what the duties are on our products, and if they were taken off entirely no harm could result, because American-made mining machinery is better and cheaper than any other. The tariff acts only to increase the cost of our product by increasing the cost of raw materials. It puts an obstacle in our way when we go out to develop foreign business, as we are met by retaliatory duties, by criticism of our prices, which we are told are upheld by high tariff laws, and by the stigma of unpopularity which follows the product of a country which main-

tains the bars of protection against its neighbors, and at the same time seeks business abroad.

Protection is not a shibboleth—not a religion. It is a practical means to an end; a temporary policy to be followed until its object has been attained. It is based on grounds of expediency, and a lower tariff is advocated on similar grounds. Protection means exclusiveness at home at a sacrifice of foreign trade. It is a course of training for that industrial and financial battle for the world's supremacy which it is our determination to win.

To argue that we should "let well enough alone" begs the question. What is well enough to-day may not be well enough to-morrow if conditions change. That conditions governing trade and commerce in the United States have changed in the past five years, who will deny? We are dealing with a great business question, and the business man who does not shape his policy to meet situations will fall behind in the race. A wiser motto than "let well enough alone" is one which has been handed down to us as a truth from Holy Writ: "Let him that thinketh he standeth take heed lest he fall."

Air Haulage.

In our last issue we published in full a paper by Mr. Richard Hirsch presented before the Society of Western Engineers, at a recent meeting, in which the subject of pneumatic mine haulage is summarized in a brief and satisfactory manner. At the same time we also printed a paper by Mr. W. B. Clarke, entitled "Electricity vs. Compressed Air, a comparison of the efficiencies and relative cost of installation of the two systems." This latter is a discussion of a single instance where compressed air is at present used. Both of these papers bring out a number of features of the Air Haulage System, and as they are antagonistic in character both should be read. Mr. Clarke is well known in the electrical industry and is an enthusiast on the subject of Electric Mine Haulage. His paper is readable and apparently would be convincing except for several serious errors in his premises.

In the first place he takes up the mines of the Susquehanna Coal Co. of Glen Lyons, Pa., where a compressed air installation has been in successful operation for some time, and outlines an electrical equipment. In so doing he takes small electric locomotives which he states are capable of hauling larger trains than the air locomotives at present are hauling. On this basis he figures out a power plant which is naturally smaller than the air plant. He then assumes that his engine for operating the electric plant will have a steam economy of 28 pounds, and says that the steam consumption of the compressor will be 34 pounds, ignoring entirely the fact that if the air plant were being installed anew with an idea of steam economy, a compressor requiring even less than 28 pounds could have been used as easily. He then charges up a boiler capacity of 300 H. P. to the compressor and explains that a 100 H. P. electric plant would hardly require any additional capacity other than that which is already used for pumps, etc. These points makes a very creditable showing for the electrical installation, but the items which actually determine the efficiency and economy of a haulage plant are ignored.

Fuel in the case of the coal mine is one of the smallest items in the total expenses, as material which would otherwise be almost refuse is used. Operating expenses, repairs, general maintenance, permanency of the equipment and flexibility of the motive power are the factors on which the success of the Air Haulage System has been built up. A compressed air equipment and air locomotives can be installed in a mine by the regular mine mechanics and can be operated and maintained without employing expert operators or repair men. As Mr. Clarke ignores the question of danger to miners and operators, and the greater danger of gas explosions we will not dwell on it, because on this basis the advantage of air haulage is so obvious that a mere mention is sufficient.

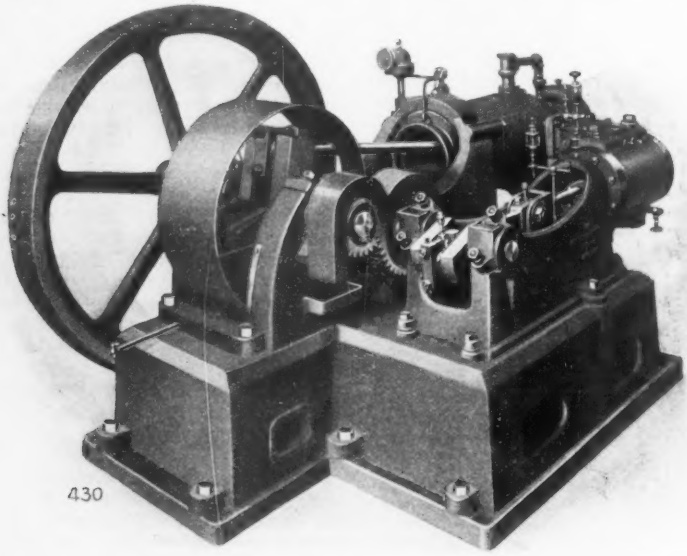
A single explosion in a gaseous mine will as a rule more than off-set the expense of two or three air haulage installations, and the chance of such explosions where electricity is used is by no means uncertain, a fact easily substantiated by an examination of the various State Mine Inspectors' reports. The presence and necessity of bare overhead wire in every gallery where the locomotive is expected to work is a menace to miners

who must pass back and forth, and the expense to install and maintain will in the long run more than over-balance the cost of any piping required by a compressed air haulage system.

The letter printed at the conclusion of Mr. Clarke's paper is a complete answer to the arguments which he presents, and is well worth the attention of any one inclined to question the economy of an aid haulage system.

A Compressed Air Fog Signal Plant.

At first glance our frontispiece does not suggest anything to do with compressed air. In reality it is a very satisfactory example of a compact, self-contained, isolated compressed air plant.



OIL ENGINE DRIVEN AIR COMPRESSOR. INGERSOLL-SERGEANT COMPRESSOR. HORNSBY-AKROYD OIL ENGINE.

The Race Rock light house here shown is built on a small island by that name and resembles in a general way other light stations and is more or less conventional in design. Inside, however, is quite an engine room.

As heavy fogs prevail at times in this vicinity, which make the light of practically no service, a fog signalling apparatus is of the greatest importance. To avoid the possibility of accidental shut down at times when the signal is most needed a duplicate plant is installed. Each outfit consists of a 7 H. P. Hornsby-Akroyd oil engine directly connected by gearing to an Ingersoll-Sergeant class "E" air compressor similar to the picture here shown. The compressor cylinder is 8 inches in diameter with a 6-inch stroke and runs at 150 revolutions, giving 51 cubic feet of free air per minute at 40 lbs. pressure. The engine runs at 235 revolutions per minute, and uses petroleum or crude oil, which is stored in the base of the engine and is automatically raised to the vaporizer by a small pump.

The jacket water necessary for cooling the cylinders of the engine and compressor is kept circulating by a small reciprocating pump actuated from the engine cam shaft.

Both engine and compressor are mounted on a substantial cast box base, and thus make a completely self-contained apparatus. The air as compressed passes over into a large air receiver or tank.

From this it passes to the reducing valve of the fog horn.

An automatic time trigger or valve allows the air to blow through the horn at specified intervals producing the proper signal whereby the station can be idenfied by passing vessels.

It frequently happens that in time of fog a plant of this sort must continue in operation for as much as one hundred hours without interruption. Add to this the fact that these signal stations are often miles from any means of repairing breakdowns and the necessity of unfailing machinery becomes apparent. The Race Rock station is only one of many compressed air fog signal stations along our extensive coast, but is typical.

We are indebted to the De La Vergne Refrigerating Co. for the use of the photograph from which our frontispiece was prepared.

Moisture in Compressed Air.

D. W. HERING.

Mistaken notions arise occasionally concerning the moisture in compressed air, especially when air has been compressed hydraulically. In the abstract of Professor Kinealy's paper in COMPRESSED AIR not long ago, speaking of the method of compressing at Magog by a descending column of water, he says "compression by such an apparatus must, of course, be quite isothermal, but the air must be saturated with moisture, and would, therefore, be objectionable in many cases." Another article in the same number, referring to the same method, says: "Tests have shown that air compressed in this manner contains only one-sixth of the moisture originally in the surrounding atmosphere from which it is compressed."

These statements appear to be contradictory and are somewhat confusing, but both may be correct.

It would seem as if there could be no more effectual way to moisten air than to mix it thoroughly with water, and that is done in hydraulic compression, but paradoxical as it sounds, this may actually be a drying process; air may emerge from it charged with less moisture than it had before entering the water, as we may presently see.

In the effort to make this plain we would better state first a few elementary principles.

In a mixture of air and water-vapor, such as the atmosphere always is, the total pressure is the sum of the pressures due to the constituents separately. At all ordinary temperatures, and through a wide range from very low to any higher temperatures the air will be a gas and will follow Boyle's law of pressures for a given temperature, or Charles' law for varying temperatures. It is not so with the vapor of water, which follows these laws only when its temperature is above what is known as the dew point.

If a small quantity of vapor be enclosed in a large space it will exert a definite pressure at a given temperature. The space being unchanged the pressure will be higher with a higher temperature indefinitely, and lower with a lower temperature, but not indefinitely.

If the temperature be kept constant and the volume diminished, the vapor present will be crowded into a smaller space and its pressure will rise in proportion up to a certain point, above which water vapor will not exist at that temperature. Any further diminution of the volume will not give any greater pressure, but will result in a precipitation of the moisture as liquid. At that pressure, called the *maximum pressure* for that temperature, the vapor is *saturated*, and this would be true whether air be present with the moisture or not.

The maximum pressure, or the pressure of saturated vapor, has been accurately determined for a wide range of temperature, and also the actual weight of the vapor per cubic foot, under these conditions:

If air is at a high temperature and is saturated with moisture the pressure of the vapor will be higher, and the quantity of water in a given volume will be larger than in air saturated at a lower temperature, but the air will be no drier in one case than in the other. In each case the humidity is 100 per cent., and in either case the slightest lowering of the temperature or the slightest diminution of the volume would be attended by the precipitation of moisture, called dew. If, however, in a given volume of air there is only half enough water vapor to saturate it, the pressure due to the vapor will be only half as great as at saturation for that temperature.

Now supppose air at an atmosphere pressure is drawn in with the column of water and carried down the shaft to a depth where it is under a pressure of four atmospheres. Suppose the air to begin with is half saturated with moisture. If the temperature is unaltered, when the air has been compressed to two atmospheres, or half its bulk, there is twice as much moisture per cubic foot as there was at first, and the tension or pressure of the vapor is now double what it was to begin with. It is at its maximum. No further compression will increase this. So long as the temperature is unaltered, there will be just so much pressure exerted by the vapor of water, and just so much water in the air per cubic foot. Further crowding of moist air into the same space will give a higher pressure of air, but so far as moisture is concerned, it will be changed from vapor into liquid and will be mixed with the flowing water. When the outside air has been reduced in volume to one-fourth its original bulk, it will be saturated with moisture, it is true, but that only means that it will contain enough moisture to exert the maximum vapor pressure for that temperature. This compressing operation will extract and carry away much of the moisture from the air. If the latter is driven into a receiving tank, from which it is drawn for power or other purposes, not only will it on expanding to its original volume and temperature, have less moisture per cubic foot than before compression, but on expanding to one atmosphere pressure it may fall much lower in temperature than before without precipitation of moisture. We began in this case with air half saturated or with a humidity of 50 per cent., and supposing the temperature to be not changed, we reached saturation by doubling the pressure.

The same thing might have occurred in another way. Beginning with air at a high temperature, even if it is only half saturated, the pressure due to the vapor of water will be considerable, and with no diminution of volume this pressure is proportional to the absolute temperature, and if the vapor (and air) be cooled down, it will presently reach a temperature for which the actual pressure of the vapor is a maximum or saturation pressure. Thus the air may be brought to saturation either by raising the pressure or by lowering the temperature.

Suppose that the air entrained by the water is warm while the latter is cold. Then as the air is cooled it approaches the temperature of saturation for the quantity of moisture in it, and when it is finally so cool that the pressure actually exerted by the vapor present in the air is equal to the maximum pressure of water vapor for that temperature it will sustain no further lowering of temperature without giving up some moisture, and if the water is cooler than this dew point, it will take moisture out of the air, even without compressing it.

In fact both of these processes are likely to occur simultaneously, and a larger drying will be accomplished than by either alone.

Perhaps one or two numerical examples will illustrate this more clearly.

If the outside air is at a temperature of say 86 degrees F., it would require .00189 pounds of vapor per cu. ft. to saturate it, and this would have a pressure of .61 pounds per square inch. If the humidity is 60 per cent., then these quantities are only 60 per cent. as much; i. e., the vapor present is .001134 pounds per cu. ft. and its pressure 0.366 pounds per sq. inch.

Suppose the water cooling it has a temperature of 59 degrees F. For this temperature the pressure that water vapor can exert is only 0.241 lbs. per sq. inch, and there will be 0.000791 pounds per cubic foot.

The original vapor in cooling to this temperature exerts less pressure in proportion to the fall of temperature, so that on this account its pressure would be 0.95 of the original. This differs so little from the original that the original figure is usually taken instead of the true one. Taking the correct value, however, the pressure of the moisture in the cooled air should be 0.95 of 0.366, or 0.348 lbs. sq. inch. But it cannot have at that temperature a higher pressure than 0.241 lbs. sq. inch, and for that purpose the air can have in it only that proportion of its original moisture that 0.241 is of 0.348; that is, $\frac{241}{348}$ or .69 per cent. It, therefore, gives up 31 per cent. or nearly one-third of its moisture by cooling, and without taking any account as yet of the effect of compres-

sion. There will be in the now cooled, but not compressed air, only .00079 pounds of vapor to the cu. ft.; exerting a pressure of 0.241 lbs. per sq. inch, and the air containing it will be saturated with the moisture. Compression now will result in further precipitation, and the higher the compression is carried the more moisture will be condensed. If the air be compressed to four atmospheres, i. e., 44.1 pounds gauge pressure, four cubic feet of air containing .00079 pounds of vapor to the cubic foot will be compressed into one cubic foot, containing just the same quantity of water vapor. Three-fourths of the moisture will be given up, or the actual amount of water now in any quantity of air will be one-fourth of 69 per cent., or a little over 17 per cent. of what was in the same quantity of outside air before it was entrained with the water.

There may be many variations of this on account of various degrees of humidity of the air, of its temperature, the temperature of the water, and the ratio of compression. Whenever the water is colder than the dew point of the air, the latter will lose some of its moisture by cooling in the water, but there may be instances in which the air will take up moisture from the water. As an extreme case of that kind, suppose the air to be at a temperature of zero Fahrenheit and very dry, say with a humidity of only 20 per cent., and the water at 32 degrees F.

The vapor needed to saturate the air at zero temperature is .0000786 pounds per cubic foot, and has a pressure of .0215 pounds per square inch. With only 20 per cent. of saturation the quantity of moisture would be .0000157 lbs. per cu. ft. and the pressure .0043 pounds per sq. inch. The water now would warm the air and increase its capacity for moisture. At 32 degrees F. the saturation pressure is .085 pounds per sq. in., and the quantity of vapor .000295 lbs. per cu. ft. The pressure of vapor by rise of temperature to 32 degrees would become .0046 pounds per sq. inch, and the air would take up more moisture until it was saturated at this temperature, or the vapor pressure was .085 pounds per sq. in. This would be in the proportion of .085 to .0046, or 18.5 times its original quantity, making .000295 lbs. per cu. ft.

Here, by the change of temperature alone, there has been a great addition of moisture, with no compression. It would now be necessary to compress the air more than eighteen-fold to deliver it at the original temperature and pressure with the original quantity of water vapor to the cubic foot.

If the pressure were only double the air would lose half its moisture and a given mass (not bulk) of it at 32 degrees F., and zero gauge pressure would have 9.25 times as much moisture per cubic foot as at first. If it were then to cool to the temperature of 0 degree F., it would give up all its moisture except .0000786 lbs. per cu. ft. by which it would be saturated instead of nearly dry.

If it had been compressed fourfold, as in the former example, it would retain one-fourth of 18.5 times, or 4.6 times the original quantity of moisture, and that would still be almost enough to saturate it. The humidity would be 92 per cent. as against 20 per cent. to begin with.

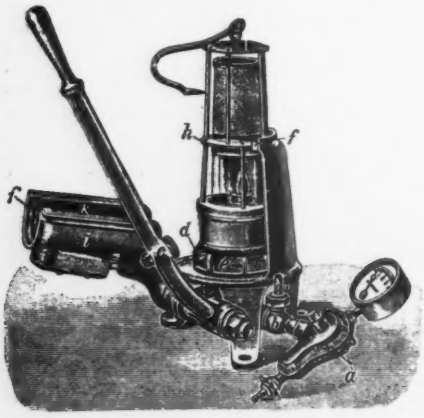
In compressing hydraulically, no moisture condensed by compression reappears in the air, as it is carried off by the flowing water, but in compressing with dry metal compressors, in which very little cooling of the air is accomplished in the compressor cylinder, practically all the moisture is driven with the air into the receiving tank, or the cooler, or the mains. Whatever may be the vessel into which the air is driven, if the air in it is cooled to the temperature it had before compression the moisture will be precipitated in it, and if the humidity and compression were both high, the quantity of water so precipitated will be considerable. For example, if the outside air have a temperature of 68 degrees F. and is half saturated it will contain .000535 pound of water vapor to the cubic foot. If this be compressed to 8 atmospheres (102.9 lbs. gauge pressure), three-fourths of the water vapor will be condensed into liquid when the compressed air is cooled to 68 degrees F. This will be .0004 pounds per cubic foot of free air, that is condensed, or four pounds in ten thousand cubic feet, which would be deposited in the tank or mains, or in the first intercooler if this were the first stage of compound compression.

If this precipitated moisture is drawn off by means of a cock suitably placed for the purpose, the air to be utilized will be drier than it was in the beginning, on reaching its original temperature and pres-

sure, by the amount of moisture it has given up. A plain discussion of this condition with some pungent remarks is contained in the sixteenth chapter of Frank Richards' book, "Compressed Air."

An Apparatus for Testing Miners' Lamps.

We illustrate a pneumatic device for testing the tightness of safety lamps. Briefly described, it consists of casing flame chamber of the lamp large enough to hold the reservoir, and is made in two halves, one of which forms part of the base of the device. The other half is hinged and provided with a lever to swing it open to admit the lamp, or closed when the lamp is in place and ready to be tested. Suitable rubber packing is provided to seal the two halves and the flange of the lamp. The closing lever also opens the valve, which admits compressed air. To observe the condition of the



flame, which flickers or goes out, according to the amount of leakage in the lamp, a glass window is provided in the front of the movable half.

A reducing valve and small pressure gauge also form a part of the apparatus, so that the pressure to which the lamp is submitted can be accurately gauged. Generally these range from 0.12 to 0.28 atmosphere, depending upon the oil being used. Different sizes of packing rings are provided so that any lamp can be tested.

The device is manufactured by the Westfalia Armaturen Manufaktur Co., of Gelsenkirchen.

A Portable Pneumatic Riveting Plant.

A recent and novel application of compressed air to the work of riveting is afforded by the roadbed reconstruction of the Scranton Railway Co., Scranton, Pa., under the direction of Mr. Frank Silliman, the general manager of the company.

The plan adopted consisted in riveting a four-foot section of old rail under each joint and involved the putting in 18¾-inch rivets at each of these places. Instead of the usual wooden ties old sections of rails were used, placed 5 feet between centres, and these also were riveted to the bottom flange of the rails, requiring four rivets each. All riveting was done with a portable pneumatic riveter of the jaw or "squeeze" type, made by Chester B. Albree, of Allegheny, Pa. This was suspended from a derrick mounted on a four-wheel flat-car, which runs on the rails of the track to be riveted. This car also carried an electrically driven air compressor made by the U. Baird Machinery Co., of Pittsburg, Pa., and driven by a 500-volt motor of the Lundell type. The air was compressed to 80 lbs. pressure in a receiver on the car. The plant is shown in the figure, which also shows one of the steel ties in place.

Power for operating the motor and propelling the car on which the outfit is mounted is taken from the regular overhead trolley wire. We are indebted to "*Engineering News*" for the illustration given herewith.

Some Pneumatic Locomotive Attachments.

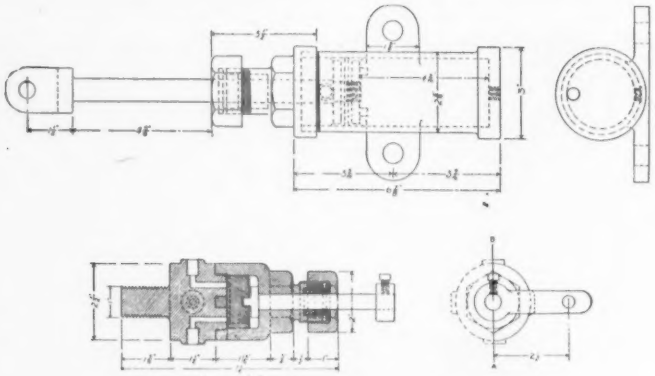
The *Railway Age* for Nov. 1 describes several novel uses of compressed air as employed by Mr. D. S. Cook, general foreman of the Evansville & Terre Haute R. R. Co.

Two of these are of more than passing interest, and we reproduce them for our readers.

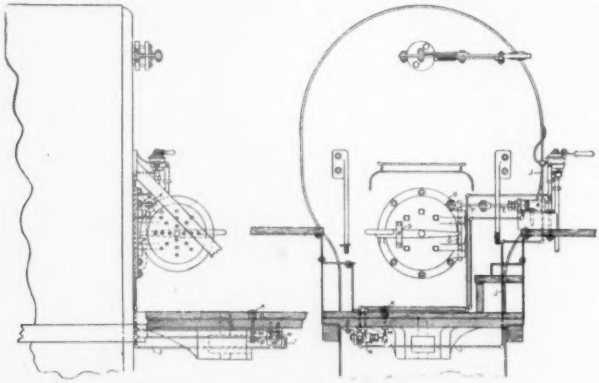
The first of these, a device for opening and closing the firebox door, shown in

RIVETING PLANT FOR RAIL JOINTS, SCRANTON RAILWAY CO.
(Showing reinforcing rail under the joint, and also one of the steel cross ties at the right.)

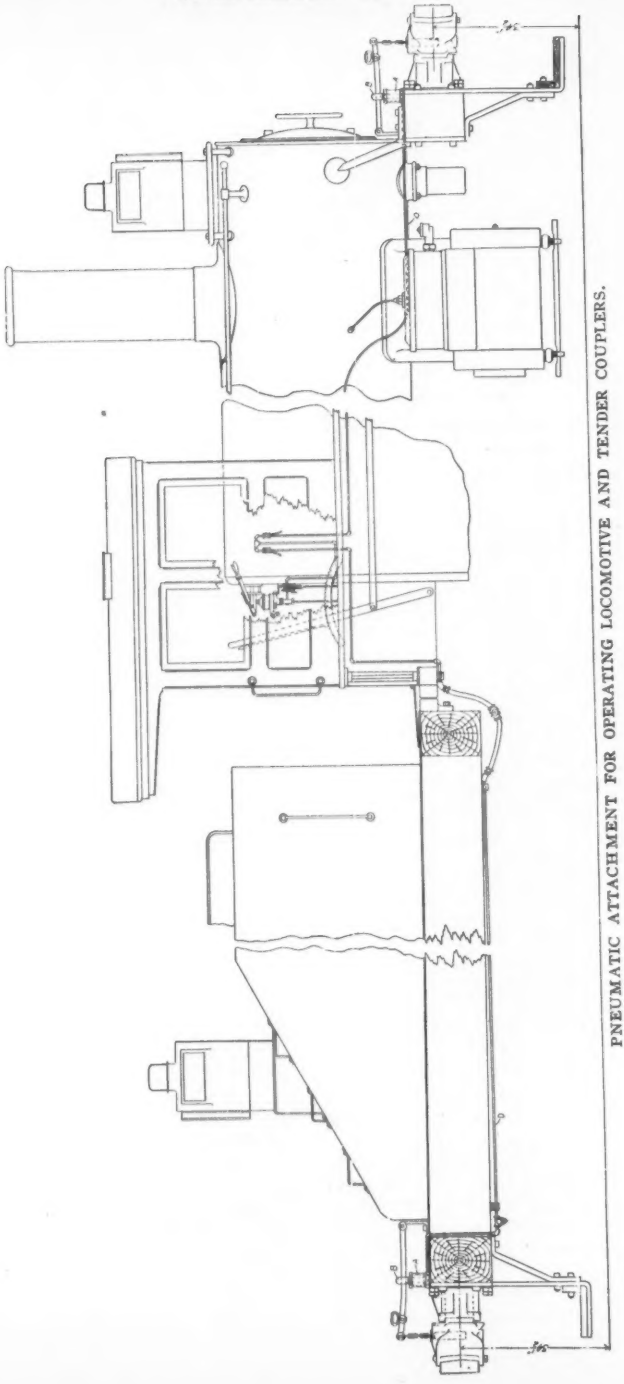
Figs. 1 and 2, consists of an air cylinder, Fig. 1, connected to the firebox door by a rod and crank lever. Two one-eighth inch gas pipes run, one from the front end and one from the back end of the cylinder, down under the deck of the engine, where they are connected with an oscillating valve. This valve is fed by an eighth of an inch pipe from the main reservoir of the air brake system. The valve is operated by the pressure of the foot on a button projecting through the floor of the cab. The operation of this button pushes down a lever which rotates the valve upon its seat and admits air through the openings in the valve, which passes into the pipe leading to the front end of the cylinder. The operation of forcing the piston to the back part of the cylinder, which is thus effected, opens the firebox door. When the button is released a coil spring raises it to its original position. This allows the valve to rotate in the opposite direction, and thus admits air to the back end of the cylinder, forcing the piston out. This operation closes the fire door. The rod which is connected with the button in the cab floor has a shoulder under the deck casting which prevents the button from raising beyond a given height. The crank lever, by means of which the door is operated, is fastened to the fire door by means of two setscrews.



PNEUMATIC ATTACHMENT FOR FIREBOX DOORS.



PNEUMATIC ATTACHMENT FOR FIREBOX DOORS.



PNEUMATIC ATTACHMENT FOR OPERATING LOCOMOTIVE AND TENDER COUPLERS.

A second device is used to raise the locking pins of the couplers at the rear end of the tender and upon the pilot. Referring to Fig. 3, the chain leading from the locking pin is connected to the end of a lever which is connected midway between this connection and its pivoted extremity to a bearing upon the stem of an air cylinder. The raising of the piston by the admission of air lifts the lever and consequently raises the locking pin from its seat. Connections are made by means of an ⅛-inch pipe and the admission of air is controlled by valves in the cab within easy reach of the engineman.

Compressed Air for Pumping Oil Wells.

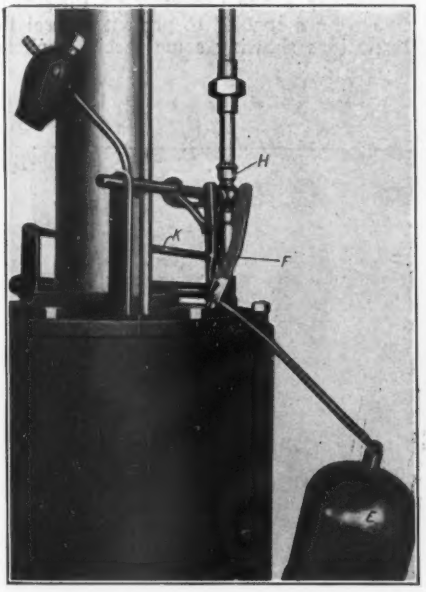
One of the latest uses to which compressed air has been put is the pumping of oil wells. California has oil fields throughout its entire length, but of these what is known as the Bakersfield or Kern River District, situate about the middle of the State, is head and shoulders above all the others, both as to present production and possible developments. In this district the formation lies almost horizontal and, with the exception of a sticky clay and heaving sand, is just hard enough to drill rapidly, but the heaving sand has been so difficult to overcome that in many cases wells that, from their surroundings were absolutely sure of oil, have, after months of constant effort, been abandoned on account of the heaving sand. It certainly requires courage and persistence in the drillers, after working for days and perhaps only gaining ten or fifteen feet, or possibly nothing at all, to run his tools into the hole and find that they will not go down within one, two or possibly three hundred feet of what they had gone but a few minutes before; and to have this experience day after day and week after week will test every virtue a man may possess, including his pocketbook. Every expedient known in other fields has been tried here, but with only moderate success. The formation being loose and open allows the water to run away so fast that the rotary hydraulic rig is a failure, though where the sand heaves inside the casing a column of water is used with good effect to aid in holding it back. Even after the oil sand has been reached and the pump put in, the troubles have only begun, as the pressure outside of the casing forces the sand through the perforations and the well has to be shut down at short intervals to remove the accumulated sand and clear the working barrel, necessitating an engine and rig at each well, and also the retaining of a "pulling crew" of at least three men. To overcome these conditions a great deal of expensive experimental work has been done by various companies, and at this time compressed air gives promise of solving the problem. The air is piped from the air compressor (too well known to need any description) to the well, a 1-inch pipe run down into the well and connected with a 3-inch tubing near the bottom by a U-joint, though in some cases two or three pipes are connected one at the bottom of the tubing, one at about three-quarters distance down and one about one-half the distance. In starting the well pumping they are all turned on together until the column of oil is started, when the intermediate connections are shut off and the lower one will do all the work, usually requiring about 120 pounds pressure in an 850-foot well, 14 gravity oil. By this method everything above the connections is carried out of the tubing and the deeper they are submerged the better the results. In this way the sand, which has been the source of so much trouble, is not allowed to accumulate, but is carried out with the oil, and by gradually lowering the tubing the well is cleared of whatever sand may have accumulated in it. In one instance which has come under our observation the well, after being completed, had filled up 180 feet with sand which, working day and night for nearly six weeks with the tools, failed to lower. As an experiment and last resource compressed air was introduced with the result that in four days, besides getting a benefit of the entire production of the well, the sand had been removed and the tubing lowered to the bottom of the hole and the well has since produced steadily. Briefly, the advantages of the new method are as follows: One man to attend to the compressor plant and one man to attend to all of the wells being pumped, instead of one man to every well and a pulling crew in addition. The compressor plant being the only machinery required, instead of an engine and rig to every well, wells can be operated at a long distance from the com-

pressing plant with practically no loss of power. Last, but possibly most important, the wells produce for thirty days in the month instead of about fifteen days, as heretofore.—*Scientific American.*

Compressed Air Oil Service.

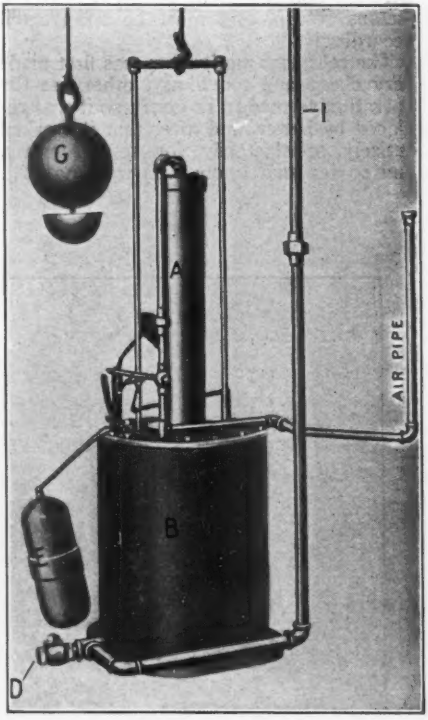
Not all rotary oil pumps supplied with machines for lubricating their cutting tools are entirely satisfactory. There is usually trouble with leaky joints, or the belts get oilsoaked and throw oil over everything within reach. It often happens that the oil supply is not needed, but still the pumps keep running, wasting work.

All these conditions existed in the case I am about to speak of. The pump, getting intolerable, was taken out and a tank set on brackets above the machine was substituted. From a tank below the attendant would fill the upper tank as often as needed, but as he had to do some climbing this arrangement was not satisfying.



DETAILS OF OIL ELEVATOR.

There was in the shop a constant supply of compresser air at 70 or 80 pounds pressure, which I concluded to use, and the photographs show the result. *A* is a 3-inch brass tube serving as an air cylinder, *B* is a cast-iron cylinder about 14 inches inside diameter. Pistons connected by a rod are fitted to each cylinder, and cup leathers are used for packing; the rod has no packing. The apparatus is single acting, and the pistons are returned to the upper position by the counterweight *C*, through the rope and rods shown. The whole thing is set into a tank, not shown, into which is led the used oil. The oil rises on the inside of cylinder *B* as well as on the outside, passing in through the check valve *D*. A small hole through the side of cylinder *B*, near the top and close under the lower piston when it is up as far as it will go, allows the air to escape, and it is closed as soon as the piston de-



COMPRESSED AIR OIL ELEVATOR.

scends a distance equal to the diameter of hole. When the oil is high enough the float *E* trips the hook *F*, the weight *G* falls and opens the air valve *H*, admitting air on top of the small piston. The pistons descend and the larger one forces the oil in cylinder *B* to the upper tank. When the piston is near to the lower limit of its travel, it strikes the rod *K*, which passes through the cylinder *A*, and this lifts weight *G* in position for another "cycle." It should be noted that the trigger on the float remains in a position to interfere with the hooking up of weight *G* until the pistons return, and must be constructed accordingly.

The releasing mechanism was first made very cheap and too flimsy, otherwise the operation seemed to be good; so it was replaced by better, and after that it worked entirely satisfactorily for several years, and so far as I know it is working still. The time of making it complete and installing was thirty-five to thirty-eight hours, and afterwards eight to ten hours for a new tripping mechanism. It required no attention except cleaning out; but if I had to make another I think I should dispense with the pistons and admit the air on top of the oil, and, so to say, "blow it up."

The advantages as I see them are: cleanliness, no belts, no bearings, noiselessness and no motion except when wanted.—*American Machinist.*

Some Special Applications of Compressed Air.

Through the courtesy of the Westinghouse Air Brake Company of Pittsburg, Pa., we are enabled to present several illustrations showing some special applica-

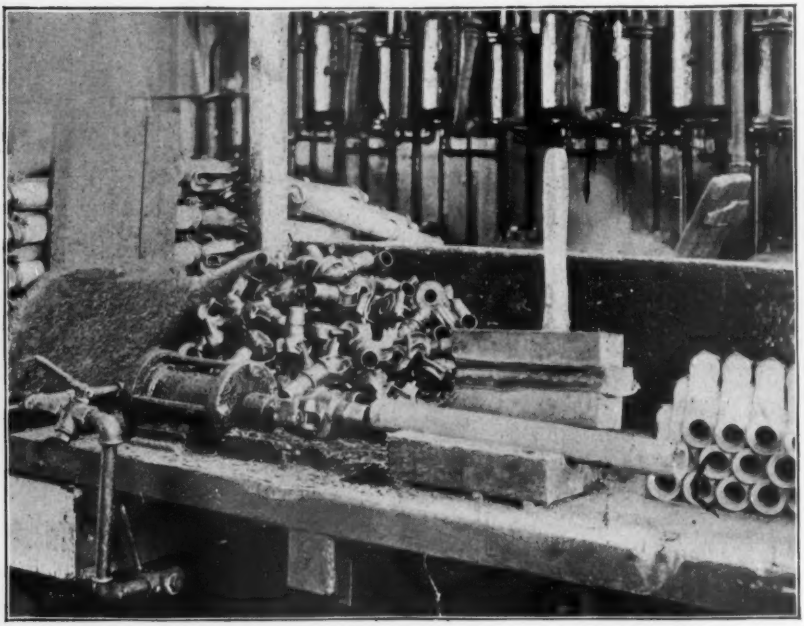


FIG. I—INSERTING COUPLING SHELLS.

tions of compressed air at their Wilmerding works.

Besides further illustrating the flexibility of a compressed air system the pictures may serve to suggest new uses to some of our readers already employing air to some extent.

Figure 1 shows a simple device for inserting coupling shells in the short lengths of hose used to couple up cars. The coupling shells are slipped on the end of a piston rod working in a small cylinder. Directly in front the hose is held between two blocks grooved to fit snugly about it. Air forces the shell into the end of the hose, while a spring returns the piston ready for a second operation.

Figure 2 is somewhat similar to Fig. 1, but has a taper mandrel on the end of the piston on which is slipped the malleable iron clamp rings used to surround and clamp the hose to the shell piece. A use of the air hoist is well shown in Fig. 3. In this, rough cylinder castings are lifted from the floor, swung over a boring machine and slid into place without effort or delay on the part of the operator, who is thus permitted to devote his strength and attention to setting and operating his machine.

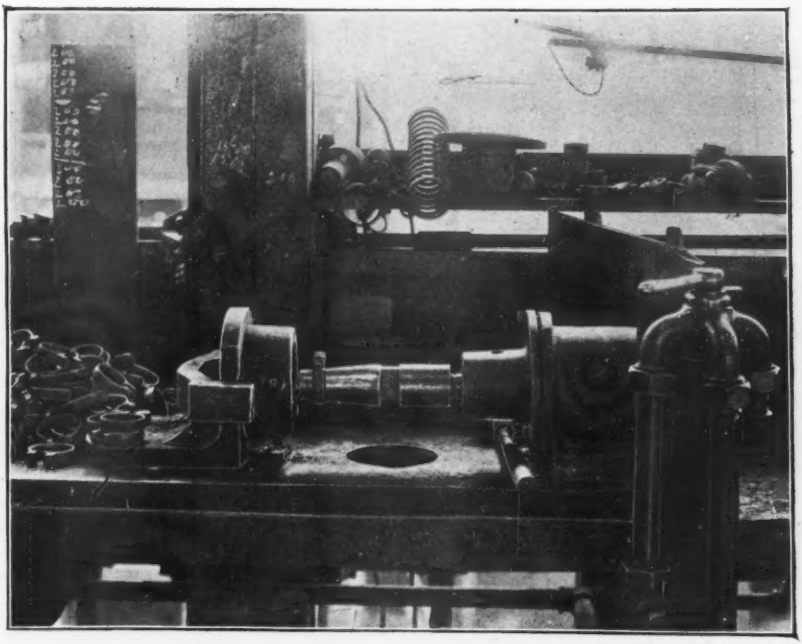


FIG. 2—ENLARGING MALLEABLE IRON HOSE CLAMP RINGS.

Figure 4 is of especial interest, and suggests many uses in shops where a large quantity of small duplicate pieces are turned out. The drill press shown is fitted with a small cylinder placed under and in the centre of the plate. A piston rod extends up through the usual central

siderable reduction in the time required to machine a given piece.

Figure 5 is simply an application of the straight air hoist suspended from a truck running on an overhead rail.

Compressed air for operating these and many other appliances in and about the

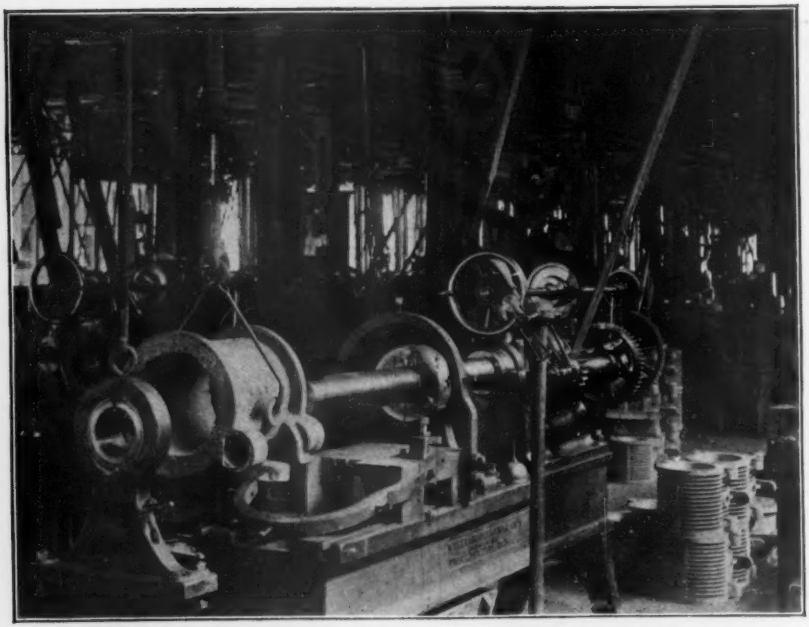


FIG. 3—PLACING CYLINDER CASTINGS IN BORING MACHINE WITH AIR HOIST.

hole and is used to clamp the work up against the face of the jig. A turn of the valve releases the pressure when the piece is free, and can be removed without slacking any bolts.

There are many places where a device of this sort could be employed with a con-

Westinghouse works is obtained from the airbrakes undergoing a test, an uneconomical method of producing air for shop purposes generally, but not so here, because the airbrake pumps must be tested, and if the air were not utilized this way it would have to be wasted.

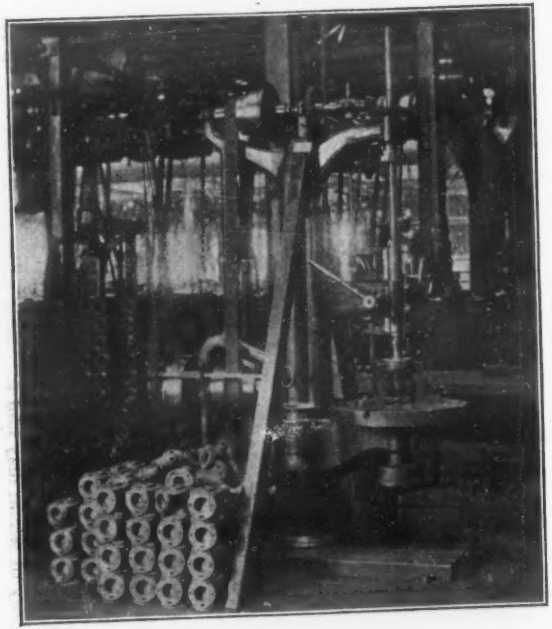


FIG. 4—COMPRESSED AIR CLAMP TO HOLD PIECE BEING OPERATED UPON.

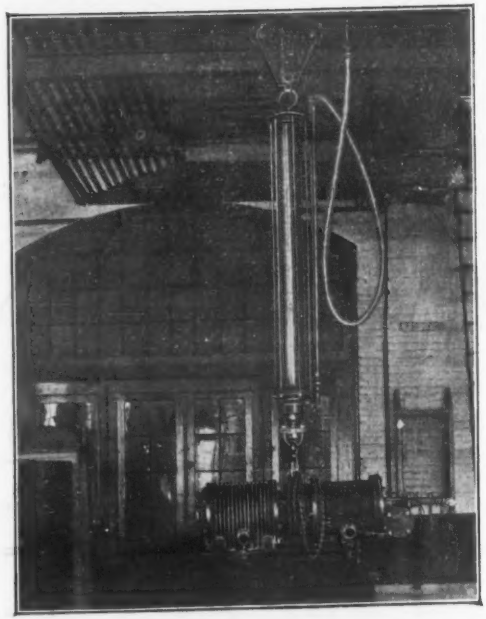
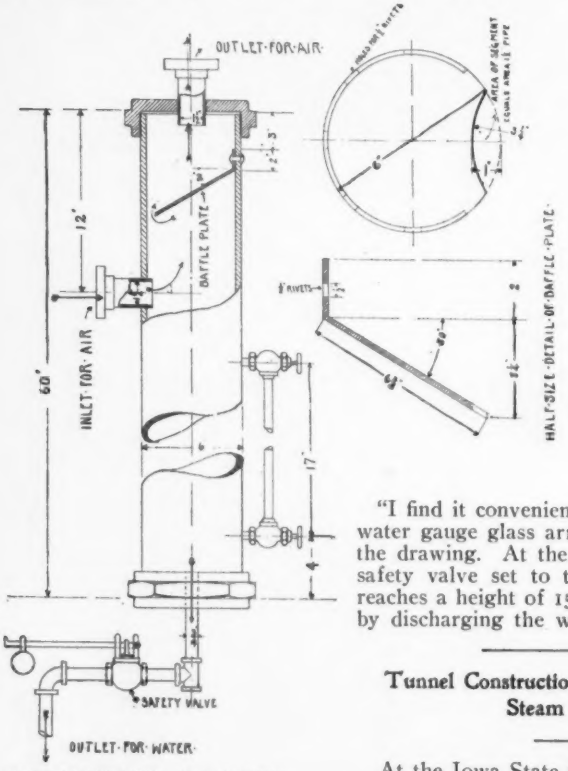


FIG. 5—AIR HOIST HUNG FROM TRUCK, FORMING A TRAVELLING HOIST.

Water Trap for Compressed Air Mains.

Sometimes in connection with the use of compressed air for operating pneumatic apparatus in machine shops or elsewhere, difficulty is experienced due to the moisture, which is present in the air in an amount, depending upon the method of compression, from where the air is obtained and also the humidity of the atmosphere.

We illustrate herewith a water trap for the removal of this moisture, which was designed and constructed by Mr. H. N. Covell, Superintendent of the Lidgerwood Mfg. Co., of Brooklyn, N. Y. We understand that this trap works with marked success and we present it for the benefit of our readers, many of whom may find it of service. Referring to this Mr. Covell says:



TRAP FOR COMPRESSED AIR MAINS.

"The sketch needs but little explanation. The trap in question was constructed from a piece of ordinary 6-inch wrought iron pipe, and is 5 feet long. The top end was tapped for a 1½-inch outlet for the air, and at a distance of 12 inches from the top the pipe was tapped for a 1½-inch inlet.

"The baffle plate shown in the drawing is set at an angle of 30 degrees from the horizontal. This baffle plate extends clear across the 6-inch pipe, leaving only a small opening, equaling the area of a 1½-inch pipe.

"I find it convenient to have a common water gauge glass arranged, as shown on the drawing. At the bottom is a ¾-inch safety valve set to trip when the water reaches a height of 15 or 20 inches, thereby discharging the water."

Tunnel Construction for Underground Steam Pipes.

At the Iowa State College at Ames, Ia., a tunnel has recently been constructed for the steam, compressed air and electric mains leading from a central power station to a new engineering building; ultimately the system will extend to the other large college buildings and be utilized for the distributing mains of a central heating plant. The tunnel has been constructed

from the plans and under the direction of Prof. G. W. Bissell. From a paper read by Prof. Bissell before the Iowa Engineering Society, the following additional details have been taken:

The total length of the tunnel is 460 feet, consisting of a single stretch 360 feet in length, with right angle offsets at the power station and at the new engineering hall of 60 feet and 40 feet, respectively. The grade of the tunnel is about 0.6 foot to the 100 feet from each end toward an assigned low point designated as station D, where a connection is made from the floor of the tunnel to a sewer, and also from a 4-inch drain tile under the floor to the same sewer, thus securing internal and external drainage. The internal drainage connection is properly tapped.

The walls and roof of the tunnel are hard-burned brick, laid up for a 9-inch wall in cement mortar, plastered outside to a thickness of one-half inch with cement mortar. The floor of the tunnel is 4 inches thick, constructed according to the usual specifications for a cement sidewalk. The extreme height of the tunnel on the outside is 6 feet, and the width on the inside is 5 feet.

At intervals of 10 feet in the length of the tunnel a 1½-inch iron steam pipe is placed to serve as a column for carrying supports for the heavy pipes. This column is supported by a flange casting at the bottom, resting on a 12x12-inch pier of concrete, and is built into the roof of the tunnel.

At the same intervals, 10 feet, and opposite the columns, are placed two wooden bricks on each side of the tunnel. These will serve on one side to support a 2x4-inch cleat, which will hold one end of the pipe carrier and serve for ring pipe hangers to carry compressed aid and vacuum pipes required for operating the thermostatic heat regulating system of the new engineering hall. On the opposite side of the tunnel will be placed a similar cleat, on which the electric lighting and power wires will be suitably hung.

The pipe-carrier consists of one-inch round iron rod, supported by a flange bolted to the cleat on the wall of the tunnel, and by a clamp casting secured to the column in the center. The carrier may be adjusted to any height desired to give the pipes thereon the required grade or fall. The pipes rest on rollers which are free to turn upon the rod, thus permitting expansion to whatever extent may be necessary.

The steam pipe will be anchored securely at two points, and the expansion between the anchorages will be provided for by the use of an expansion joint of standard design. The amount of expansion thus to be provided for will amount to about 5 inches in the extreme cases. The expansion occurring on the outside of the anchorage, and toward the ends of the tunnel, will be provided for by the spring in the offset.

The steam and return pipes will both be thoroughly protected from wasteful radiation of heat by covering them with the best grade of sectional pipe covering. The pressure to be maintained in the steam pipes may be anywhere from atmospheric to 80 pounds to the square inch, but it is not expected that more than 40 pounds to the square inch will be required at any one time.

The lighting of the tunnel itself has been provided for by placing overhead a half-inch iron pipe conduit with receptacles and lamps at intervals of 30 feet. The conduit is supported on brackets on the central column.

The cost of the tunnel, including excavation, brick work, cement work, drain tile, iron columns, wooden brick and backfilling, was $3,300, approximately $7 per foot. The installing of the pipe, including steam, return, compressed air and vacuum pipes and the hangers therefor, and including the lighting of the tunnel itself, is now in progress and will cost $1,800, or about $3.90 per foot complete. The total cost, therefore, for the whole construction will probably be about $11 per foot. In comparing the cost of this construction with others frequently used it will be noticed that it is quite high, but, on the other hand, it is expected that the construction, at least of the tunnel part, will last for all time, and it is reasonable to assume that on account of the accessibility of all of the pipe and electric circuits, that they will be kept in better condition than if buried under the ground, and, on account of these features, that the running expenses due to the radiation of heat occasioned by the deterioration of the insulation will be reduced to the very lowest figures.

Another advantage is in the use of the tunnel for electric light and power circuits. This exists in the fact that the same will be under ground, thereby doing away with the unsightly overhead poles and wiring system, and doing away with the liability of such overhead wires becoming entangled or being blown or broken down.—*Engineering Record.*

A Portable Pneumatic Riveting Machine.

The riveting machine illustrated in the accompanying half-tones is designed for work on beams and girders in bridge building. The levers, turning on a fulcrum, contain at one end the dies for forming the head of the rivet and at the other end are connected to a toggle joint; the center of the linkage being attached to the piston rod of a pressure cylinder. The arms are interchangeable, so that one set will straddle the edge of girders, while the other will serve to drive rivets in plates where several rows of rivets have to be driven and a protruding nose is required to reach them—a condition existing in the rivet work on some car trucks for which the present design has been found well adapted. Three machines

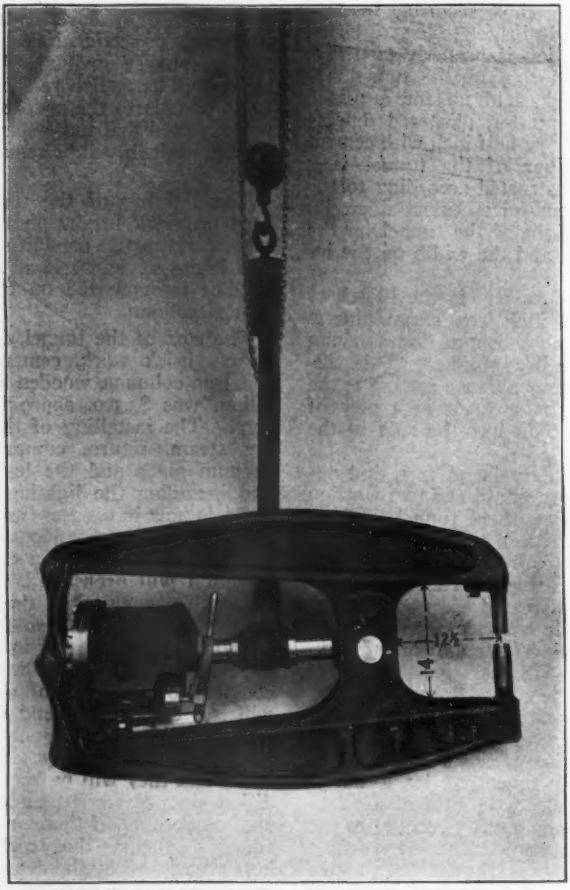


FIG. I.—ALLEN PORTABLE PNEUMATIC RIVETER.

have been built for the Sterlingworth Railway Supply Co., to be used in close work on plates in their cars.

The pressure used on the machine is from 60 to 75 pounds to the square inch, and the arms are of sufficient strength to drive one-inch rivets. In consequence of the peculiar construction of the toggle joint, a small ten-inch cylinder will produce at the end of the stroke, or when the dies are nearly closed, a pressure upon the rivets of about fifty tons. The means employed for the suspension of the machine are conveniently arranged. The tool is attached to a suspension arm by a knuckle joint at the center of gravity and the whole apparatus may be turned to any desired position with great freedom. The advantage of this construction can be seen in the ready application of the tool to almost any position in which a rivet may be placed provided the gap of

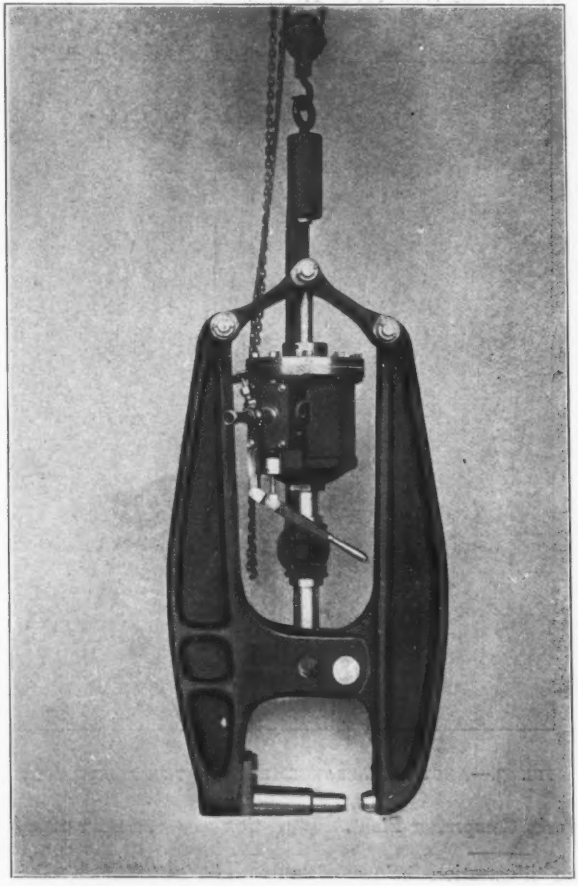


FIG. 2.—ALLEN RIVETER ARRANGED FOR VERTICAL WORK.

the machine will allow the dies to reach the ends of the rivet. The general adaptability of the device is thoroughly shown in the engravings where the one machine may be seen in various positions.

The weight of the tool under consideration is 1,250 pounds, and it is manufactured by John F. Allen, 370-375 Gerard avenue, New York.—*The Iron Trade Review.*

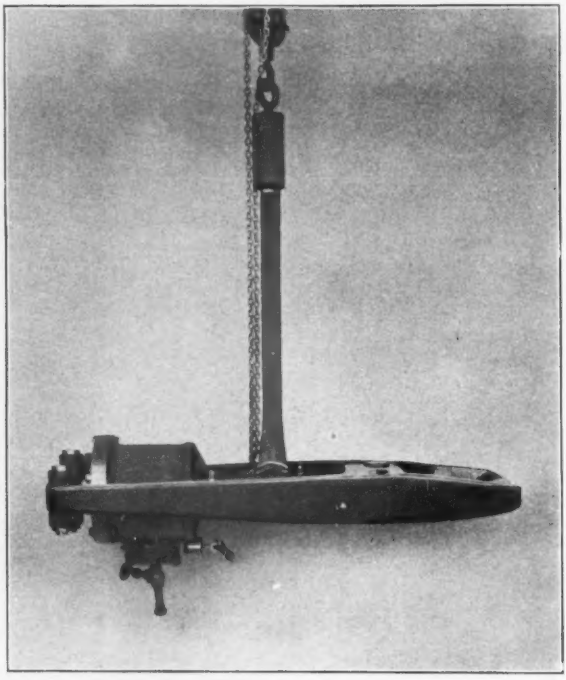


FIG. 3.—ANOTHER ARRANGEMENT OF THE ALLEN RIVETER.

Boiler Works Compressor Plant.

We give an illustration below of a compressor plant installed at the boiler works of S. Freeman & Sons, Racine, Wis., by A. J. Fisher, of 50 South Clinton street, Chicago. It has a capacity of 300 cubic feet of free air per minute and is of 10-inch bore and 42-inch stroke. The compressor is attached to an E. P. Allis Corliss engine 26x42 inches and operates tandem fashion, furnishing air for operating pneumatic tools and a three-ton pneumatic elevator. No changes were made on the engine except the reconstruction of a new back cylinder head suitable to receive the compressor. The back cylinder head was fitted with a stuffing box to receive the piston rod of the compressor and the head was drilled and tapped to attach the two tie rods which hold it firmly in position. No foundation was necessary except enough to carry the weight of the compressor.

The piston rod of the compressor is screwed into the piston of the engine operating in unison and in a direct line. The compressor is supplied with an automatic unloading and regulating device that regulates the air compression accordingly as the air is consumed. This feature makes it a very economical and effective machine, as no air is compressed unless the receiver pressure falls below

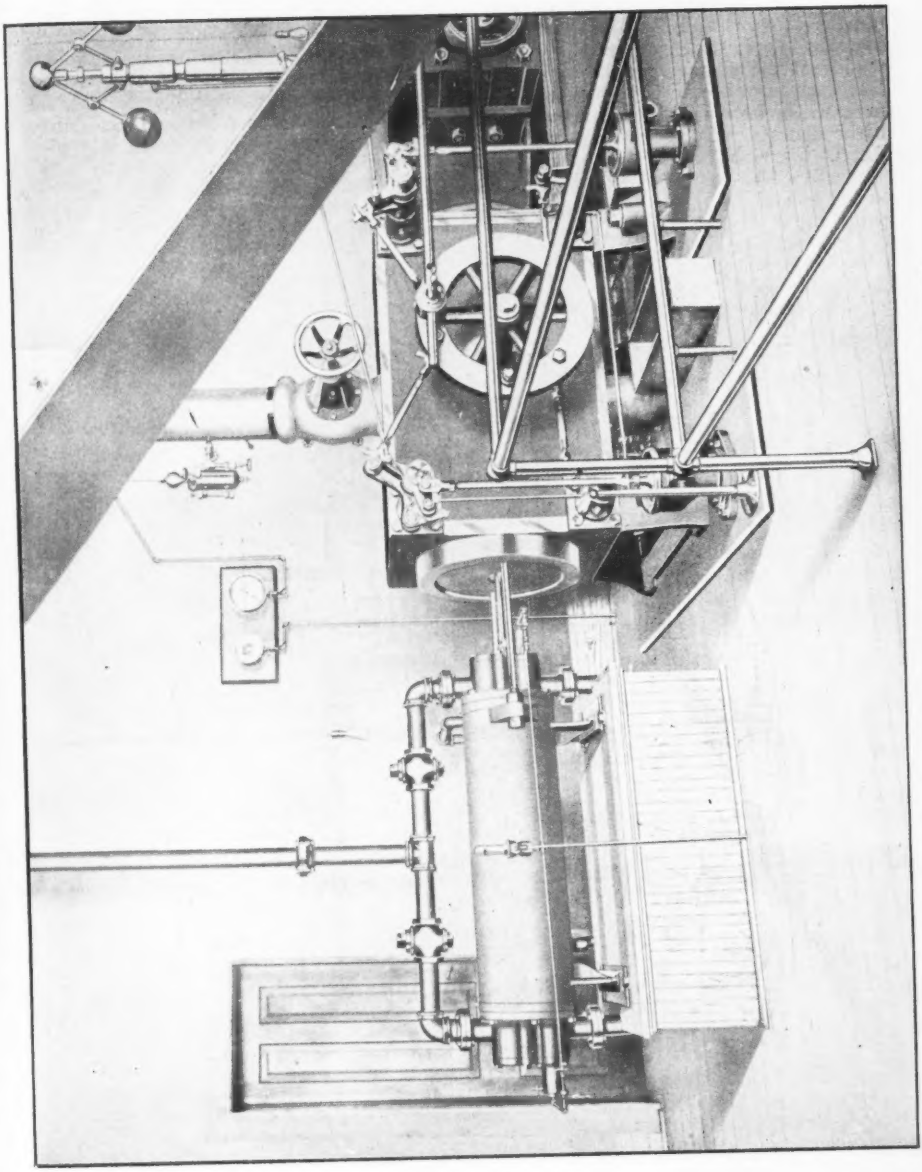
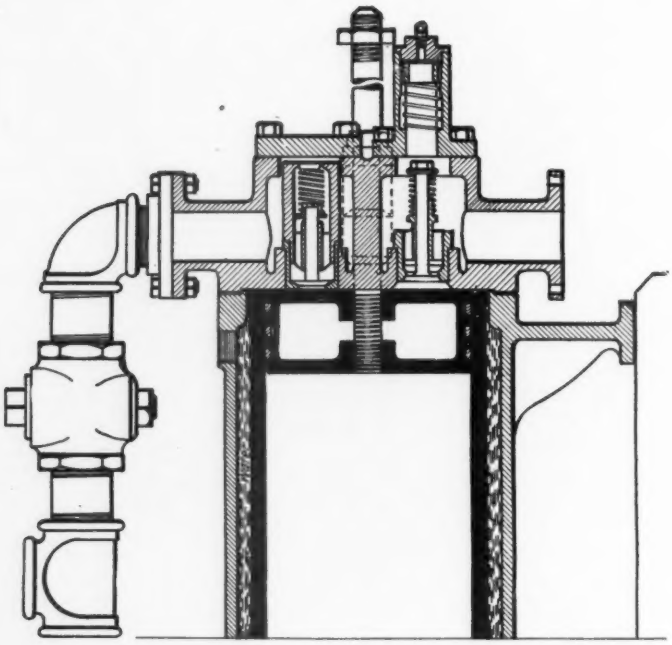


FIG. 1.—FISHER COMPRESSOR ATTACHED TO CORLISS ENGINE.

the point set on the regulator, the result being a saving of fuel. The air cylinder is thoroughly cooled by a water jacket and the compressor is so arranged that a free air supply can be piped from the outside of the engine room.

The capacity of the compressor can be increased or decreased by a simple change in the diameter of the inner cylinder and piston. For instance, if the bore is five inches in diameter and the stroke 18 inches, the capacity may be increased by removing the five-inch cylinder and substituting one that is 10 inches. No change is required in either of the valves, cylinder heads or water jacket. This change can be quickly made and at a nominal cost. Their construction will be understood from the section elevation, Fig. 2.—*The Iron Trade Review.*



SECTIONAL VIEW, FIG. 2—AIR COMPRESSOR CYLINDER, SHOWING VALVES IN DETAIL.

COMMUNICATIONS.

Under this heading will be published inquiries addressed to the Editor of COMPRESSED AIR. We wish to encourage our readers in the practice of making inquiries and expressing opinions.

We request that the rules governing such correspondence will be observed, viz.: all communications should be written on one side of the paper only; they should be short and to the point.

One of our correspondents writes us as follows:

Editor COMPRESSED AIR:

"Do users of air compressors encounter any difficulty from deposits of scale, etc., in the water jackets, and what means are resorted to for removing such deposits, if they occur?"

In answer to this we may say that the question is purely one of the character of water used for jacket cooling. Any water which will cause a scale or deposit in a boiler will certainly cause a deposit in the jacket of a compressor, but, of course, to a less degree, as the formation of scale is dependent to a considerable extent upon the degree to which the water is heated.

If it is possible, use the water you employ in your boilers. In cases where this cannot be done and ordinary well water or water rich in lime must be used, it is well to wash out the jackets at frequent intervals, using for this purpose a jet of hot water.

In extreme cases, and especially where the formation of deposit is rapid, the cover plates can be taken off and the inside of the jackets scraped while being washed down with a jet of hot water. In some instances the formation of scale or deposit cannot be prevented, and when this is found to be the case the only remedy is to scrape the jackets as far as possible and continue running until the jacket becomes clogged and the flow of water prevented, when the cylinder can be removed and sent to the factory for overhauling. Or, if means are at hand the cylinder liner can be taken out, cleaned and put back. In this, as in other matters, "An ounce of prevention is generally worth a pound of cure," and in extremely bad cases filtration or some such means can be employed to advantage.

Notes.

H. H. Stoek, editor of *Mines and Minerals*, has been elected president of the Engineers' Club of Scranton, Pa.

It is reported that the Chicago Pneumatic Tool Company has absorbed the Standard Pneumatic Tool Company of Aurora, Ills.

The Pneumatic Crane Co., Pittsburg, Pa., has sent us a copy of an attractive little pamphlet describing its self-traveling trolleys. Size, 6⅜x3½ inches.

So far there is no determined limit to the distance that compressed air can be carried. Air has been utilized at a distance of five miles from the compressor.

The C. H. Shaw Pneumatic Tool Company, C. H. Shaw, proprietor, Denver, Col., who for the past three years have been engaged in the manufacture of pneumatic hammers, have been incorporated under the same name with a capital stock of $50,000.

At a depth of 20,000 feet the air would have such compression because of its own weight that a temperature of 60 degrees F. at the mouth of the shaft would be near 300 degrees at the bottom. A depth of 10,000 feet is probably the limit of deep mining.

We have received an illustrated circular from M. H. Treadwell & Co., 95-97 Liberty street, devoted to descriptions of the various types of wooden freight cars manufactured by this concern, who succeed the Lebanon Mfg. Co., of Lebanon, Pa. They will gladly send this upon request.

It is quite an uncommon occurrence when a well equipped railroad yard can not boast of an air compressing plant for cleaning and other purposes, and we find that the New York Central & Hudson R. R. R. Company's power plant at Albany, N. Y., which they have recently equipped,

is no exception to the rule, they using this power for the cleaning of cars and for air brake testing.

According to *Popular Science Notes*, the Montreal Board of Trade has lately had on exhibition a model for a contrivance to brake ships, so that they can be stopped almost instantly in case of threatened collision, or when a person falls overboard. The device consists of two or more doors on each side of the ship beneath the water line, attached outside to the sheathing and opening outward. The doors can be operated by electricity, steam or compressed air.

A site is being surveyed by the American Car & Foundry Company at Berwick, Pa., for the new plant to be erected at that place for the manufacture of steel cars. The main building will be 200 by 700 feet, which, with annexes, will cover about 200,000 square feet of ground. The building will be of steel and brick construction, and will be equipped throughout with electricity and compressed air. The new plant will be located north of the rolling mill and wheel foundry.

The Blanchard Machine Company, 16 Harcourt street, Boston, sends a little pamphlet devoted to the Blanchard air compressor. The principal feature of this compressor is that all the working parts are enclosed and are oiled by the splash method of lubrication, the same as in various new types of high-speed engines. The machines are also provided with valves of a new design, which do not pound on the seats, being air cushioned at the ends of the stroke. The catalogue is 6x3½ inches, standard size.

The Stehn Manufacturing Co., Sheboygan, Wis., builder of engines, air compressors and machinery, is crowded to the limit with orders from foundries for air compressors and for its automatic sand blast apparatus which it recently placed on the market. The latest plant equipped with this sand blast apparatus was that of the Rundle Mfg. Co., Layton Park, Milwaukee, Wis., who report they have been able to clean, in some cases, four times the amount of castings that could be cleaned by hand.

The Sullivan Machinery Co., of Claremont, N. H., and Chicago, Ill., have established a branch office at 306 St. Louis street, El Paso, Texas. This extension was rendered necessary by the increased business of this firm in the southwest and Mexico. It will be recalled that the already extended business of the Sullivan Machine Co., has recently been augmented by the purchase of the entire plant and equipment of the M. C. Bullock Mfg. Co., of Chicago, and the capacity of this latter plant is now being doubled by the addition of large erecting and machine shops.

The new Chamber of Commerce building stands on the corner of Liberty street and Liberty place, New York, and is conspicuous in the district of the 22-story office buildings for being only four stories high. The contractors for the structural steel work were Messrs. J. B. & J. M. Cornell.

Pneumatic hammers were used in this work, the compressed air being furnished by an Ingersoll-Sergeant compressor with a capacity of 210 cubic feet per minute. The receiver had a 2½-inch pipe with two 1¼-inch rising lines; these were each fitted with four ¾-inch valved outlets for hose connections which supplied three Chicago Pneumatic Tool Company's hammers and one Little Giant reamer.

The Philadelphia Pneumatic Tool Co. have let the contract for their new plant (previously mentioned in these columns) to J. E. and A. L. Pennock; ground has been broken and active building operations started. This company report a very favorable condition of business, the shipments for export to England and the Continent having been particularly large, and a decided increase has been noted from this market as well as from the domestic field. Numerous shipments of pneumatic tools are also to be noted for various shipyards and large steel works. The Philadelphia Pneumatic Tool Company have recently established an agency for the Pacific Coast, Berger, Carter & Co. 310 Market street, San Francisco, Cal., being their representatives.

The Pneumatic Railway Signal Company, Beckley Building, Rochester, N. Y., recently organized, will take over the Pneumatic Railway Signal Company and

the International Pneumatic Railway Signal Company, two corporations organized under the laws of West Virginia, and the Standard Signal Company of Troy, N. Y. The Standard Company have been for several years manufacturing railway signal devices, and for the past three years have been the installing agent of the system of low pressure pneumatic interlocking signals, covered by patents owned by the Pneumatic and International Pneumatic Railway Signal companies. The new company will continue the operation of the Standard Company's plant at Troy. J. N. Beckley is president.

The Standard Pneumatic Tool Co. have appointed Mr. J. B. Wilson, formerly connected with the mechanical department of the Grand Trunk Railway, manager of their new Canadian offices, which have just been opened at 103 Union Station Arcade, Toronto, Ontario, at which place they will carry a full line of their "Little Giant" Pneumatic Tools and Appliances, repair parts and accessories.

In the future all machines for Canadian customers will be shipped direct from their Toronto office, thereby saving purchasers the inconvenience of making out manifests and paying duty.

Their business in Canada has greatly increased during the past few months, and the outlook is very encouraging.

At the construction of the Aspen-Wyoming tunnel on the Union Pacific R. R., air drills were used for both headings and the shaft, and, rather amusing to say, for the "steam" shovels also. The plant was located about 3,000 feet outside of the east entrance to the tunnel, and consisted of three piston inlet air compressors, one of size 24 ins. and 24¼ ins. by 30 ins. stroke, and one of 22 ins. and 22¼ ins. by 24 ins. stroke, all with a combined horse power of nearly 600. The air is conveyed as far as the mouth of the shaft in a 6-in. main, and from here to the west end in two 3-in. mains. At points where the pipe is tapped to draw off a portion of its supply, a small reservoir is placed to equalize the pressure whenever there is any sudden draft.

The Cambria Steel Co.'s new works are situated near Franklin, on the left bank of the Conemaugh River, a short distance from Johnstown, Pa. The power plant, furnishing electric power and compressed air to all portions of the new works, is located in its own group of buildings near the structural plant. It contains four 400-kw. Westinghouse 200-volt generators, each being directly connected with a compound condensing Southwark engine. The engine room further contains four air compressors capable of delivering 1500 cubic feet of air per minute; also an expansion pump of 500 pounds pressure for operating the shears in the beam yard. The boiler house contains four Babcock & Wilcox 300 horse-power boilers fitted with Murphy automatic stokers.

The Ripley Hardware Co., Grafton, Ill., are offering an improved compressed air glass jar hand sprayer. The operation of the sprayer is described as follows: The air is forced into the reservoir by pumping, in the same way as with any sprayer. The reservoir has a brass discharge tube, extending to the bottom and an air tube at the top, which allows the air to blow the solution out in the form of a continuous fog mist on all parts of the foliage. It is stated that it will spray in any position, including overhead. One filling of a 1 quart jar, it is explained, will spray 500 hills of potatoes, thus saving half of the usual time and labor. A 1 or 2 quart Mason glass jar will fit the sprayer. It is pointed out that nothing but the best material is used in the construction of the sprayer, and that leather washers are used on the jar, which are the best for use when spraying oily solutions.

A pneumatic tube system for delivering parcels is in successful operation in Boston. From the main station at Essex street and Harrison avenue, in the retail store district, parcels are sent 1½ miles to the "Back Bay" station and one mile to the "South End." There are two lines of common cast-iron pipe 10-in. in diameter. These are not bored out, but the joints are carefully smoothed and laid like water pipe. The carriers run on five small wheels at each end which have stood

service tests of more than 8,000 miles. With this construction no packing is required, and this is the greatest improvement embodied in this application. Very simple transmitters and receivers are used and a pressure of 2 ibs. per square inch is sufficient to give a speed of 30 miles per hour. Air power is supplied by a motor-driven 24 by 12 in. Rand compressor. From descriptions already published, this appears to be a distinct advance over previous pneumatic transmission methods.

In our February number there was illustrated and described in detail a powerful pneumatic forging machine in use at the Burnside shops of the Illinois Central R. R., which has attracted considerable attention and comment. In connection therewith it is interesting to note a very powerful bull-dozer, operated by compressed air, which is in use at the McKees Rocks shops of the Pittsburg & Lake Erie Railway. This forging machine is fitted with tandem cylinders, each 30 inches in diameter, placed on a horizontal frame made up of two 16-inch beams. The piston rod or plunger arm is 5 inches in diameter, and with 100 lbs. air pressure in the reservoir, the cylinders being placed in tandem, a working or effective pressure of about 70 tons can be exerted. The arrangement is such that either cylinder can be cut out so as to use the pressure from a single cylinder for light work, in order to economize in the use of air, or both cylinders can be operated when greater pressure is desired for heavy work. The forms and tools which have been devised for use with the machine permit of performing a great number of the jobs required in locomotive, passenger or freight car forgings. The machine will upset 5-inch square iron when the latter is properly heated.

The water supply for the Central Heating & Lighting plant for the county buildings, Indianapolis, Ind., is obtained from an 8-inch well by means of an air lift. For this purpose there are two double-acting Rielly air compressors 14x14-inch steam cylinders and 12x14 air cylinders, arranged to maintain a working pressure of air of 75 pounds per square inch and operated under the control of a governor to maintain a constant water level in the receiving tank for the water. The air from the compressors is discharged into a receiver 36 inches in diameter and 5 feet long. This is constructed of flange steel having a tensile strength of 60,000 pounds, shell ¼ inch thick and dished heads ⅜ inch thick, and is tapped for a 2-inch connection to the air-pipe in the air-lift. The water receiver, which takes the discharge from the air lift, is 60 inches square and 6 feet high, and constructed of ¼-inch steel. The well is about 500 feet deep and the water level when pumped at the required rate is at the greatest about 50 feet below the level of the basement floor. The capacity of the air life system is about 500 gallons per minute under these conditions. The suction to the water pumps is taken from the bottom of the water receiving tank, both for the water supply and the boiler-feed pumps. The water supply pumps are equipped with the Fisher Pump governor, selected large enough for both pumps.

At the main shops of the Cincinnati & Southern Ry. at Ludlow, Ky., the principal feature of interest is the extent to which compressed air is used in connection with the various shop tools, etc. It is used for air hoists over the machine tools, etc., for air riveters (by pressure, not hammering), for painting cars and for operating the transverse table in the yard. It is also applied to a yard-testing plant for testing the brakes after trains have been made up. A large Ingersoll-Sergeant compressor is used, and the air pipe line carries a pressure of 100 lbs.

The Cincinnati Southern Ry. is of peculiar interest historically in that it is a municipally owned line, having been promoted and built by the city of Cincinnati, Ohio, for the purpose of connecting that city with Chattanooga, to connect with the Southern systems of railways. There were originally 27 tunnels in the road, varying from 189 feet to 3,984 feet in length, but the last one of the line, near Emory Gap, has given so much trouble, the disintegrated shale rock having slipped at one time and crowded in the timber lining (although the lining was exceptionally heavy) that it was found neces-

sary to build a new line. This new line swerves off to the southeast, skirting the ridge pierced by the tunnel. The contract was let to M. J. Condon & Co. of Knoxville, Tenn., and was completed in 1901. When rock was reached compressed air drills were used with steam derricks for loading the dump cars.

The Delaware, Lackawanna & Western R. R. have recently designed a snow plow capable of turning around directly on the track, and plowing back again over the same ground. This is done by means of a turntable arrangement self-contained with the car for turning the plow end at any point on the main track, without having to use a stationary turntable or one such as is in ordinary service for turning engines. This plow was completed during the early part of the winter.

The manner of turning the plow is simple. There is a turntable track about three feet in diameter attached to the front truck of the car, and at or near the centre of the car there is a bolster with a centre bearing to fit the truck and six 8½ inch wheels arranged in a circle to bear upon the turntable track. In order to turn the plow the front end of the car is raised by means of compressed air cylinders, to clear the forward truck, which is then rolled back under the centre bolster or bearing. The weight of the car is then supported by the truck under the centre, the rear truck hanging to the car body. The turntable device being then located at such a point that the car body is balanced over the centre truck, the plow is turned by pushing it around with a couple of men.

The arrangement for hoisting the front of the plow clear of the truck at that end is a 12-inch air cylinder on each side of the car, opposite the centre of the truck. It is a downwardly acting piston, which takes a bearing on blocking placed on the ends of the ties. We are informed that this arrangement for lifting the cars by air was worked out in the company's shops at Scranton, Pa.

Various systems of independent motor cars, operated by steam, compressed air or oil engines, have been experimented with at different times. In 1899 a motor car of generally similar type was built by the Vimotum Car Co., of Chicago, and tried on the Pennsylvania lines, at Indianapolis, but this never got beyond the experimental stage. The car resembled those used on interurban electric railways, and was 41 ft. 6 ins. long, and 8 ft. 6 ins. wide, mounted on a pair of four-wheel trucks with 33-in. wheels. The front end of the car was supported by a steel bolster supported by the outside frame of the truck. On the forward truck (and within the car) was mounted a 45-H. P. Wolverine vertical three-cylinder gas engine, belted to a countershaft, while a second countershaft carried a pinion which engaged with a spur wheel on the front axle. Each countershaft had a pulley of variable diameter, connected by a stiff belt, this arrangement forming the Reeves variable-speed transmission system. The machinery was supported on an inside frame of the driving truck. The car carried a water tank for the circulating system of the cylinder jackets, and was fitted with the Christensen air brake. It weighed about 22 tons, and was designed for a speed of 25 miles per hour, although it attained a speed of 40 miles an hour on a trial trip. Nothing came of this, but the company has since been working on a steam car, having a triple-expansion marine engine to drive a similar transmission system. The Compressed Air Co. of New York was at one time working on plans for a large car to operate on suburban service as a main line of railway, but no such car has been put in service.

A correspondent of the *Engineering and Mining Journal* writes: The success which has attended the application of the chlorination process to the extraction of gold from the Cripple Creek ores has stimulated the efforts of the friends of cyanide as a solvent. Among the several new ideas or applications of well known principles in order to simplify and perfect the cyanide process, is that of the agitation of the solution, and the oxidation of the contents of the leaching tank. Among these methods is that patented and applied by the Pneumatic Cyanide Process Company, with headquarters in Denver, Col.

That all solutions are expedited by agitation is an axiom in all chemical and industrial processes. Accepting this fact, this company also claims that agitation

by means of air currents not only hastens the action, but that the oxygen of the air is an important factor in supplementing the simple agitation or stirring of the mass.

To accomplish this latter result, currents of air are injected into ordinary tanks through perforated pipes that rest on the burlap or canvas filters at the bottom. The injection of the air current is continuous with the introduction of the solution and pulp. By this means it is claimed that a gentle agitation causes the heavier and coarser grains to seek the bottom, and thus the slimes, which are the bane of all these percolation processes, are kept in suspension until the latest moment. When the discharge valves are open the air currents are still operated, though under a decreased pressure, and by the gentle stirring of the lower layers of sand it is claimed that the solution can be drawn off in a much quicker time and in equally good shape as by the simple filtration. A new mill employing this method has lately been installed on the Gold Standard Mine at Idaho Springs.

The St. Louis, Iron Mountain & Southern Railway Company's bridge across the Arkansas River at Little Rock, has several fixed through spans and one swing span, built in 1884-85. The piers are of stone masonry on timber caissons sunk to rock, about 45 feet below the low-water line. After the pier was built the sand commenced to wash out under the caisson, especially at high water, so that the pivot pier and one other pier soon began to lean upstream, and in 1898 this became so much exaggerated that it was determined to try to stop farther displacement of the pivot pier by building a new caisson around the old one and work was immediately started with this object in view.

The caisson was lowered at the rate of about 1 foot per hour by about eighty men, three being stationed at each screw to slack off the nut with a wrench 5 feet long, moving a quarter turn at once, by signal. The walls of the cofferdam were built up and the caisson lowered until the cutting edge rested on the sand at the highest point of the river bottom. The surface of the sand was so irregular that the water was 4 or 5 feet deep under the cutting edge at some points, and it was filled in at these places by about 12,000 bags of sand, carefully dumped close to the caisson to build up a support for the cutting edge. The bags were made of burlap and contained about 0.8 cubic feet of sand each, as much as a man could conveniently carry. By this means all but about 40 feet of the 460 lineal feet of cutting edge was supported at a distance of 35 feet below the surface of the water.

Sand was filled in the cofferdam to a depth of about 4 feet above the roof of the working chamber, and air at a pressure of 15 pounds was pumped through 1,200 feet of 4-inch pipe from two compressors on shore. The sand was excavated and was discharged through 4-inch pipes by both the wet and the dry blow-off. Many old piles were encountered and were removed piecemeal by dynamite. The air pressure was blown out to reduce it 10 or 15 pounds at intervals, when the caisson was sunk. The caisson was sunk into the solid rock at all points and concreted and filled in the usual way. The surface of the rocks was very irregular, varied from very soft to very hard, and was blasted with dynamite. It was removed in buckets of 20 cubic feet capacity, which were operated by a derrick on a barge alongside and could make a round trip about once in five minutes. The space between the old and new caissons was filled with concrete to a height of 30 feet above the cutting edge, and all farther scouring, settling or tipping of the pier has thus been prevented.

U. S. PATENTS GRANTED JAN. 1902

Specially prepared for COMPRESSED AIR.

690,468. AIR-BRAKE VALVE MECHANISM. Edward G. Shortt, Carthage, N. Y., assignor to International Air Brake Company, Jersey City, N. J., a corporation of New Jersey. Filed March 11, 1901. Renewed Oct. 18, 1901. Serial No. 79, 111.

690,630. ROCK-DRILL. Arthur C. Bates, San Francisco, Cal. Filed April 6, 1901. Serial No. 54,759.

A rock-drill a machine-casing having a forward and rear chamber, said forward chamber inclosing parts of its mechanism and said rear chamber being provided with vents for

admitting air therein, a plunger provided with a recess for inclosing a spring to drive it forward and having a flange or head at the mouth of said recess adapted to fit closely against the walls of said rear chamber so as to permit of the formation of a cushion of compressed air between said flange or head and the forward inclosed part of said rear chamber surrounding the recessed portion of said plunger slidable therein, in combination with a cam-wheel having two parts for successively forcing back said plunger and compressing said spring and suddenly releasing the same, and having spurs on the rim thereof to act in conjunction with pockets in said plunger opposite thereto for twisting the same, a cam adapted consecutively to act upon and release a feed attachment provided with a pawl arranged to engage the teeth of a ratchet wheel attached to a feed-screw for the forward movement of the machine.

690,675. DESPATCH-TUBE. Fred R. Taisey, Indianapolis, Ind., assignor to The Taisey Pneumatic Service Company, Indianapolis, Ind., a corporation of Indiana. Filed May 9, 1901. Serial No. 59,520.

690,681. APPARATUS FOR CARBURETING AIR. Paul R. Van der Made, Breukelen, Netherlands. Filed July 16, 1901. Serial No. 68,488.

690,687. ROCK-DRILL. Alvin M. Ballou, Denver, Colo. Filed May 6, 1901. Serial No. 58,916.

An electro-mechanical rock-drill, the combination of a driving-wheel 6, having holes, a disk provided with loose tapered keys and with springs holding said keys in said holes, and a shaft, upon which said wheel is loose and upon which said disk is mounted with friction-rolls for permitting rotation in one direction and not in the other, a motor for driving said wheel, a crank on said shaft, and a plunger for holding a bit connected up with said crank against the resistance of the spring.

690,706. PNEUMATIC-TIRE PROTECTOR. Clarence G. Dinsmore, Staatsburg, N. Y. Filed April 18, 1901. Serial No. 56,389.

690,744. AIR-CONDUCTING TUBE. Francis Line, Cleveland, Ohio. Filed June 27, 1899. Renewed Nov. 4, 1901. Serial No. 81,054.

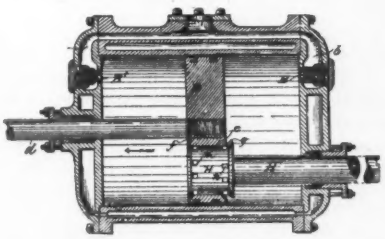
690,894. PNEUMATIC-DESPATCH-TUBE CARRIER. Albert W. Pearsall, Mount Vernon, N. Y. Filed April 3, 1901. Serial No. 54,208.

A carrier or receptacle comprising inner and outer sections pivoted eccentrically with respect to one another.

690,935. PNEUMATIC TIRE. Alfred Ducasble, Paris, France. Filed Feb. 28, 1901. Serial No. 49,199.

691,034. PNEUMATIC FEED-CONVEYER FOR FEED-CUTTERS. Edwin C. Wilharms and Adolph J. Wilharms, Greenleaf, Wis. Filed May 6, 1901. Serial No. 59,017.

691,042. PISTON-VALVE FOR AIR-COMPRESSORS. Burtwin L. Brinton and William P. Brinton, Bradford, Pa. Filed April 23, 1901. Serial No. 57,073.



An air-compressor or analogous apparatus, a cylinder, a piston working in said cylinder, a piston-rod rigidly connected to the piston for operating the same, a valve traveling with and moved by the piston but having a limited movement in an opening therein whereby the position of the valve is changed at each reversal of the direction of travel of the piston, and a hollow stem on and movable with the valve working through an opening in one end of the cylinder and adapted to communicate with the interior of the cylinder on one side or the other of the piston according to the position of the valve relative to the piston.

691,069. AIR-LOCK FOR CAISSONS. John F. O'Rourke, New York, N. Y. Filed Dec. 30, 1896. Serial No. 617,437.

An air-lock for caissons, comprising a shell convex at top and bottom and provided with end openings, a single gate for closing the

bottom opening, the gate corresponding in shape to the shape of the shell, a pair of oppositely-arranged swinging gates to close the top opening, said gates being geared together so as to move in unison, counterbalances for the upper and lower gates, mechanism for working the gates, and means for admitting air to and exhausting it from the shell.

691,082. APPARATUS FOR MEASURING AIR CURRENTS. Joseph Thompson, Manchester, England. Filed Jan. 5, 1901. Serial No. 42,261.

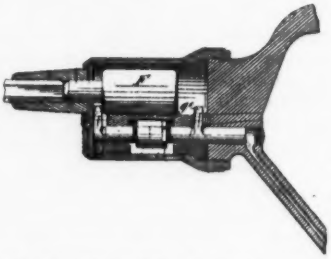
691,091. APPARATUS FOR PURIFYING PAPER-PULP. Albert Aberg, Hermagor, Austria-Hungary. Filed March 23, 1901. Serial No. 52,564.

691,278. COMPRESSED-AIR WATER-ELEVATOR. John L. Latta and James A. Martin, Hickory, N. C. Filed Oct. 20, 1898. Renewed May 25, 1901. Serial No. 61,951.

A liquid-elevating apparatus, the combination with liquid-chambers provided with valved inlet-ports, and a communicating liquid-conveyor, of valve mechanism including separate pressure-chambers, in communication, respectively, with the liquid-chambers, a rocking valve having inlet and exhaust ports in communication with said pressure-chambers, means controlled by the level of liquid in the liquid-chambers, for causing an initial movement of the valve, when the contents of the liquid-chamber have been partially discharged, and a counterbalancing device connected to and movable with the valve, and having a plurality of independently-movable weights for successive movement as the valve advances to different positions to continue the movement of the same.

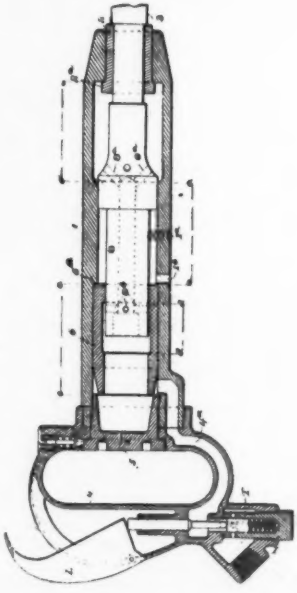
691,334. PNEUMATIC CUTTING-TOOL. John W. Birkenstock, New York, N. Y., assignor, by direct and mesne assignments, to the Empire Pneumatic Tool Company of the State of New York, N. Y. Filed May 7, 1901. Serial No. 59,140.

A pneumatic cutting-tool, consisting of a cylinder, a recessed handle suitably attached to said cylinder, a valve for admitting air under pressure, a lever for operating said valve and located in the recess of said handle, a piston in the cylinder, provided with a hammer for actuating the tool, a tubular slide-valve provided with lugs projecting into the path of the piston, ports for supplying com-



pressed air alternately to each end of the cylinder, and suitable outlet-ports.

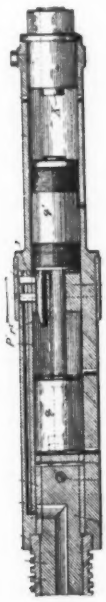
691,420. MOTOR-FLUID-OPERATED TOOL. Henry H. Vaughan, Chicago, Ill., assignor to Ridgeley and Johnson Tool Company, a corporation of Illinois. Filed March 19, 1901. Serial No. 51,828.



A constant-pressure motive-fluid-operated tool, the combination with a suitable cylinder having an exhaust-port for that end of the cylinder which contains the greater head of the piston, of a differential piston having through-ports which are radially disposed at

or adjacent to its lesser head, and means for maintaining constant pressure of the motive fluid on the lesser head of the piston in the direction of the tool.

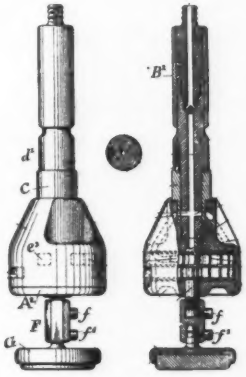
691,556. ROCK-DRILL. Herman Leineweber, Chicago, Ill., assignor to L and L Pneumatic Tool Company, a corporation of Illinois. Filed May 27, 1901. Serial No. 62,120.



A rock-drill, the combination with a support of a drill-holding shaft, a fluid-pressure-actuated drill-hammering device on the forward end of the shaft, a casing on the opposite end portion of the shaft slidingly mounted on said support, a fluid-pressure-actuated shaft-turning rotary motor in said casing, a feed-screw upon the shaft, a friction-clutch between said shaft and feed-screw, and an adjustable feed-screw engaging and releasing sectional nut on the support for advancing the rotating feed-screw and shaft.

691,726. PNEUMATIC PICKER FOR LOOMS. Josef von Miniszewski, Petrikau, Russia, assignor of one-half to Theofil von Mohl, Wyszki, Russia. Filed Oct. 21, 1899. Serial No. 734,394.

691,740. PNEUMATIC POLISHING-TOOL. John W. Birkenstock, New York, N. Y., assignor, by direct and mesne assignments, to the Empire Pneumatic Tool Company, New York, N. Y. Filed Feb. 25, 1901. Serial No. 48,777.



A pneumatic grinding and polishing tool, consisting of a tubular spindle for the compressed air, a casing attached to the lower end of said spindle, a paddle-wheel in said casing, having a shaft journaled at the lower end of said spindle, air-supply channels in the spindle and casing for supplying air to diametrically opposite sides of the paddle-wheel, outlet-ports in the casing adjacent to the supply-channels, reversing means for supplying air to one or the other of said supply-channels, and a polishing or grinding tool attached to the lower end of the shaft of the paddle-wheel, so that the spindle-shaft and tool are aligned.

691,862. PNEUMATIC CAR-SPRING. Paul Herpolsheimer, Seward, Neb. Filed March 28, 1901. Serial No. 53,279.

A car-truck, the combination with spaced bolster-plates of sustaining-springs disposed between the plates and lying flat thereon, each spring consisting of an endless hermetically-sealed tube, brace-plates secured to the front and rear edges of the upper bolster-plate and having slots in their lower ends, and bolts passing through the slots and into the front and rear edges of the under bolster-plate.

691,788. COMBINED AIR AND EXPLOSIVE ENGINE. Robert Lundell, New York, N. Y., assignor of one-half to Charles J. Kintner, New York, N. Y. Filed March 29, 1900. Serial No. 10,634.

A compound engine having a high-pressure and a low-pressure cylinder and pistons located therein, said cylinders being provided with gas-ports for admitting an explosive gas against the full free faces of the pistons and additional ports for admitting a gas under pressure against the other faces thereof, the cylinders being so interconnected that the gas under pressure as it leaves one of them is admitted at lower pressure as it enters the other.

691,936. PNEUMATIC-DESPATCH-TUBE SYSTEM. Edmond A. Fordyce, Chicago, Ill., assignor to Arthur S. Temple, trustee, Boston, Mass. Filed Sept. 20, 1901. Serial No. 75,942.

692,015. PNEUMATIC SWITCH AND SIGNAL. John W. Keeney, Coalburg, W. Va. Filed Dec. 31, 1900. Serial No. 41,651.

The combination with a compressor; of a bellows, a pipe connection between said compressor and bellows, a strip connected to the bellows, and formed with a double inclined lug, a forked bar adapted to receive the strip and formed with notches, said strip being movable a short distance independently of the bar, a switch connected to the bar, and a pivotally-supported locking-bar adapted to engage the notches in said bar and the lug of the strip.

692,184. PNEUMATIC BARKER. Charles R. Kline, Beechwood, and Julius Keller, Philadelphia, Pa.; said Keller assignor, by mesne assignments, to said Kline. Filed April 29, 1901. Serial No. 57,882.

A pneumatic barker, a casing, a pneumatic motor in the upper portion of said casing, a cutter in the lower part of said casing, the latter being open at its lower portion, and shaped so as to form a hood for said cutter, and power-transmission devices intermediate said motor and cutter.

692,194. PNEUMATIC MOTOR. Charles L. Davis, Chicago, Ill., assignor, by direct and mesne assignments, of one-half to August Heuer, Jr., Charles A. Brown, George L. Craig, and A. Miller Belfield, Chicago, Ill. Filed Dec. 17, 1900. Serial No. 40,141.

A pneumatic motor, the combination with a bellows, of a passage communicating therewith, an exhaust-passage, a passage connecting the bellows-passage and exhaust-passage and communicating with the latter by way of a port formed at the end thereof, the said connecting-passage having an air-port, and valve mechanism controlling the port of the exhaust-passage and the air-port of the connecting-passage.

692,202. PNEUMATIC MOTOR. Charles R. Kline, Beechwood, and Julius Keller, Philadelphia, Pa. Original application filed April 29, 1901, Serial No. 57,882. Divided and this application filed July 6, 1901. Serial No. 67,281.

A rotary engine, a casing, a piston-chamber therein, a rotary piston therein, said piston consisting of a cylinder, having diametrical plates at the opposite ends thereof, journals projecting from said plates and having their bearings in said casing, a sliding blade having its ends seated in said plates and its sides provided with packing devices, and a plurality of rollers arranged in pairs within said piston between which rollers said blade passes, in combination with a plurality of chambers located in said casing in opposite portions thereof, said chambers having ports leading therefrom to said piston-chamber, and said chambers and ports being adapted to be utilized as inlet or exhaust for the motive fluid according to requirements.

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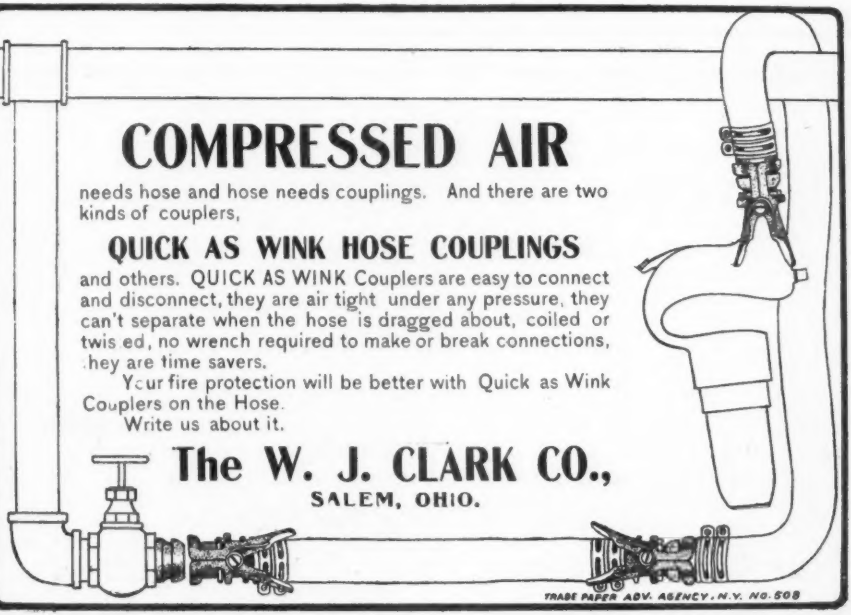

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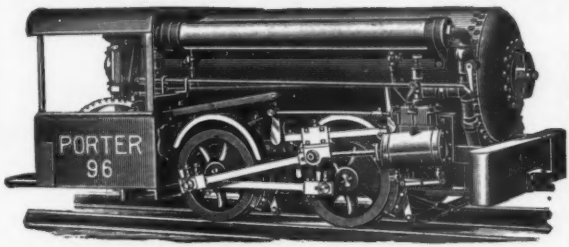

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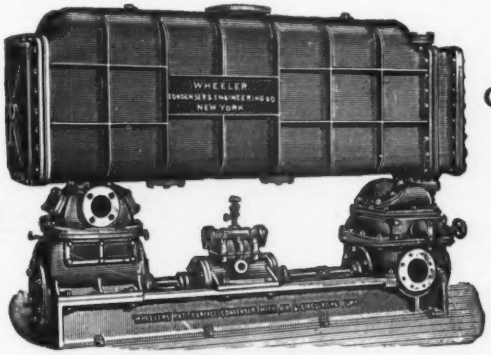

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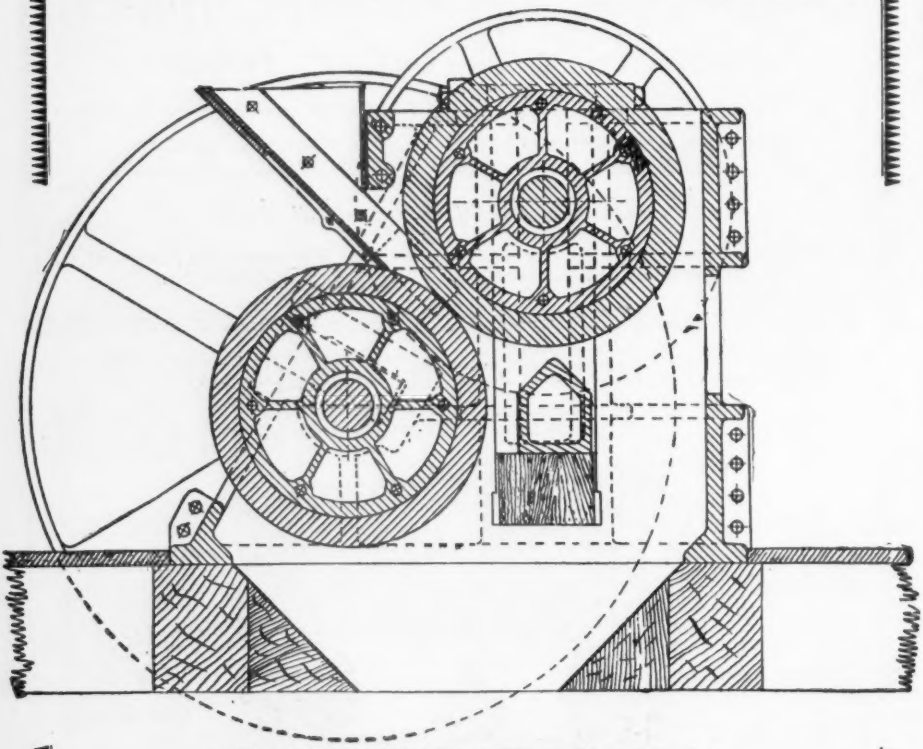

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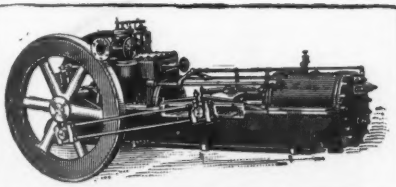

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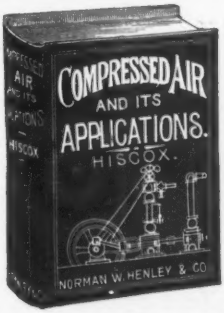

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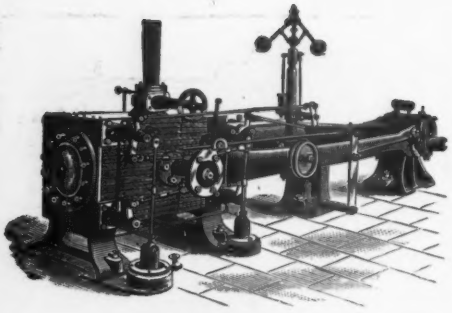

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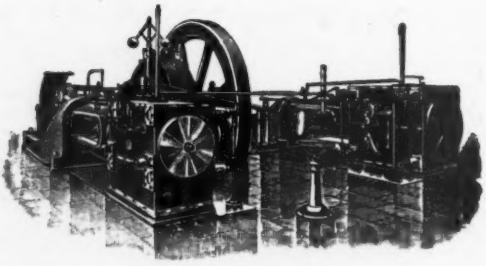

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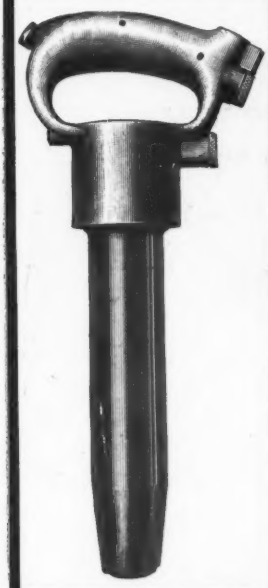

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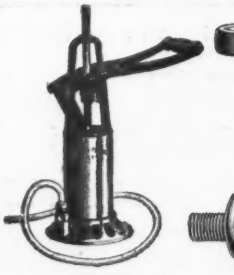

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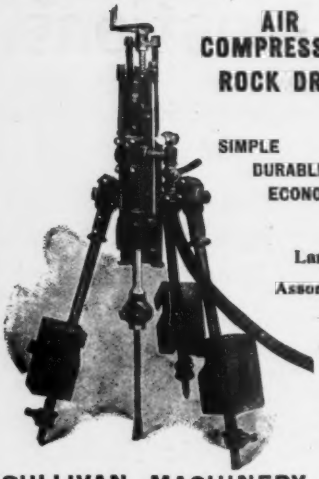

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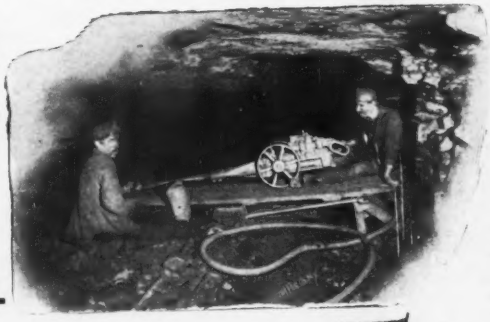

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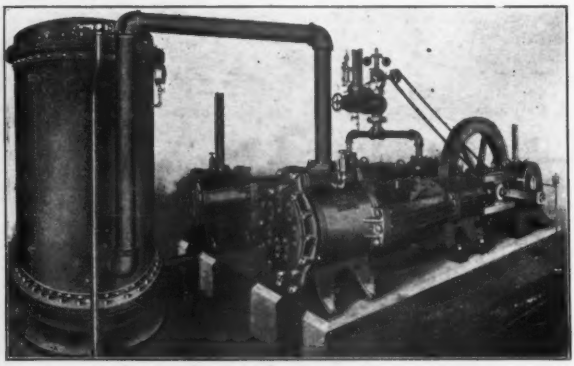

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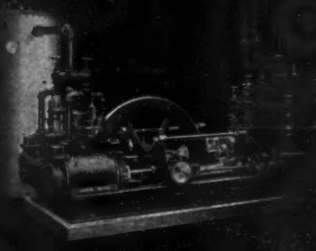

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